CHEMICAL & METALLURGICAL ENGINEERING
ESTABLISHED 1902
VOLUME 45 MCGRAW-HILL PUBLISHING CO., INC. NUMBER 3
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MARCH 1938

Regimenting Research

UNDER a free competitive economy, such as we have been proud to call the American system, prices and wages are measures of value. Under certain European economies, these values are arbitrarily established by governmental dictation as part of a program of social and economic control of industry. Under the latter system of government, it must be admitted that chemical industry and chemical profession have made some progress in research and in the development of new industries. In the five year plans of the U.S.S.R. and the autocracy programs of Germany and Italy, for example, chemists and engineers have held key positions of responsibility and leadership. Are we coming to that in this country? If so, perhaps we should be prepared for that eventuality.

Lately we have heard a great deal about prices. We are told that some must go up and some must go down. Why? The clear implication is that the President of the United States has the legal power to make some prices rise and others fall. Although this issue is debatable, at least under our present laws, nevertheless the end result is likely to be achieved. We are told that building materials are too high, whereupon all buying immediately ceases and a new housing program is wrecked before it gets started.

We face the prospect of some type of wage and hour legislation in the near future. We are promised that it will not be as drastic as its original sponsor had hoped. Yet it will add that much more artificiality and governmental control to industrial production in which lies our only hope for restoring employment and creating the goods and services that can lower prices and increase consumption.

But, to date, the one unrestricted field for free enterprise and initiative lies in the research laboratory. "If scientists and engineers turn their attention as strongly to the creation of employment and investment opportunities in the future, as they have to technological advancement in the past, they cannot fail. . . . A broad program of research is the prerequisite to the development of a flow of new industries to take up the slack in employment as well as to provide adequate capital outlets to absorb the billions of dollars available for investment. . . . You hold within your grasp the lifeline of Democracy. You share in great measure the responsibility for the destiny of society as a whole."

Who is speaking and to whom? It is Representative Jennings Randolph of West Virginia addressing the annual meeting of the American Engineering Council on "the necessity of restoring a balance between the rapid development of labor-saving devices and the slower appearance of industry-creating, job-making inventions and discoveries." The remedy he prescribes has been introduced in Congress in the form of HR-7939 to establish a Scientific Research Commission. Under its control "governmental research agencies, university and college laboratories, as well as non-profit-making research organizations will be united in a coordinated program of intensive research." Power to approve all research plans and projects and, most important, to grant funds for carrying out the work are to be vested in this new governmental commission.

As technical men we may well ask ourselves some questions: Are we ready for regimentation? Are science and engineering so badly in need of support and appreciation that we must trade our independence of thought and action for jobs in a governmental program of subsidized research? Or should we help private industry to prove that the American system, in the long run, can contribute most to the general good?

From an EDITORIAL VIEWPOINT

DIXIE HONORS HER BENEFACTOR

UPON DR. CHARLES H. HERTY, who has done more than any other to attract the attention of the world to the economics of pulp and paper production in the Deep-South, are being bestowed many well deserved honors. While on more than one occasion he has refused to accept credit for development of the processes in use, it is his matchless ability to publicize the advantages of the South for pulp and paper making that has induced many far-sighted leaders in the industry to make enormous investments of capital in new mills along the coast from Virginia to Texas.

In December the city of Savannah, Ga., joined with its "most famous citizen" in celebrating his seventieth birthday. At the official opening in January of one of the new kraft mills, that of the Container Corp. of America at Fernandina, Fla., a bronze plaque was unveiled which dedicated the plant to him. On Feb. 15 Governor Rivers of Georgia signed a bill creating the Herty Foundation which is authorized to take over the Savannah laboratory in which Dr. Herty has made many of his investigations, and to raise funds for its permanent support. The trustees are also authorized to receive funds from other states and sub-divisions, from individuals and corporations. Contributing states will have a right to share in shaping the future policy of the laboratory.

Every state in the southern pine belt has participated in the prosperity that has come as a result of the influx of new mills within its borders. Southern legislatures, prominent citizens and corporations might well afford to do honor to this distinguished son of Dixie by contributing to the Herty Foundation. Not only have they already benefited from his work but they stand to gain much more in the future.

CAN WE POOL PATENTS?

MONOPOLY based on patents is being criticized sharply by official Washington. Some of the claims of detriment to the public through improper restrictions based on patents are altogether unwarranted. But there is just that small percentage of truth underlying the charges sufficient to give them importance, and even undue credibility.

Companies that depend on patent protection must take account of this official thinking. It will not be enough to hide behind cherished tradition that patents are a vested right of industry. It will not suffice to say that Congress "will certainly not revoke present patent rights or limit those of the future." There is too much talk about restricting patents to justify the conclusion that nothing will be done. And there are a few cases of abuses of patents which are bound to magnify evils when the anti-monopolist begins to orate.

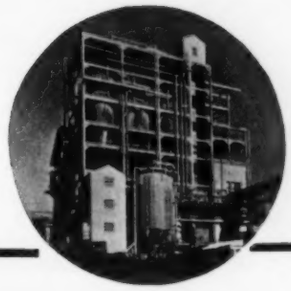
Some members of Congress have thought for some time that compulsory licensing of patents is desirable. One extreme measure suggested that a patent owner be required to license an applicant to go into competition with him three years after the granting of the patent. The bill that made this proposal is too absurd to secure enactment, but it does picture a trend of thinking that will have some weight.

Perhaps more feasible, though less talked about, are proposals that a certain amount of pooling of patents should be encouraged as "in the public interest." It may be that chemical enterprises will find such pooling of patents as advantageous to our industry, and to the public, as have been the very successful arrangements of the automobile manufacturers. In any event, it is important just now to think about these matters, and to study each corporate situation with reference to possible future activity under conditions that may provide less complete patent protection than under the laws and practices of the recent past. Ignoring of the trend is unwise. So too is panic over extreme legislation, which threatens but will not pass.

NO TIME LIKE THE PRESENT

STREAM POLLUTION studies are becoming increasingly fashionable in chemical engineering circles. Some of the larger manufacturers of chemicals have set about a systematic survey of all their plants and auxiliary stations to make certain that no pollution problems are being left unsolved. The occasion for this is obviously the impending legislation which promises to put a new vigorous federal agency back of the effort to protect the waterways of America from needless and preventable contamination.

In the past the Engineer Corps of the U. S. Army and various states have had regulations and have enforced some control of effluents. But as compared with the possibilities now anticipated, this effort has been both occasional and casual. A national view is about to be taken by federal



officials. This means that everyone must now become interested.

Elsewhere in this issue is a brief discussion of this problem. It is an extremely important one, involving both technical and economic considerations. No wise engineer or executive will wait until compelled to study his own plant in relation to possible sources of stream pollution.

CAN THE LEOPARD CHANGE HIS SPOTS?

IN THE ISSUE of March 24, 1924, *Chem. & Met.* had occasion to review the record and various promotions of one Dr. Glen Lenardo Williams. A three-page editorial entitled "Easy Money from Aluminum" ended as follows:

> The conclusion seems irresistible that he (Dr. Williams) is a discredit to the profession of chemical and metallurgical engineering and a menace to industry; that his processes are technically unsound and commercially impracticable; that they have been the cause of loss to investors and disappointment to employees; and that in the interest of the public welfare he should be exposed and his promotions suppressed. It matters not whether he is merely incompetent and deluded or whether he has operated with fraudulent intent; the consequences to industry and to the profession are alike disastrous.

This 14-year-old conclusion is now repeated because we have discovered, to our disappointment, that Dr. Glen Lenardo Williams is still with us and again up to his old tricks. His most recent activity has been in New York City, where he is said to have interested capital in a weird process for producing aluminum, "liquid ammonium," urea, ethylene and various lethal gases by the treatment of shale with "barium carbonite" and producer gas. We have in our possession a signed copy of a letter soliciting funds for a new engineering enterprise—Alabama U. S. Nitrate Plant No. 1 Corp.—said to be incorporated under the laws of the State of Delaware and claiming to have "obtained a 20-year lease from the Tennessee Valley Authority for Nitrate Plant No. 1 including all machinery, equipment and buildings, together with 400 acres of land, as by Congress Act of 1933." Reference is made to the "formulae for a new light metal alloy that is so light it almost floats on water yet has a tensile strength of approximately 103,000 lb. to the sq.in. and will not corrode or tarnish and can be tempered and will take the acid tests." It claims to have 10,000 acres of ore land near Sheffield, Ala.

Inquiry of substantial citizens of that community reveals that on the occasion of Dr. Williams' last visit to Sheffield he left without paying his hotel bill and that certain other irregularities of his conduct and behavior were noted. We also learn of an enterprise known as "Electronic Pure Metals, Inc." of Denver which was organized to exploit Dr. Williams' chemical process and had a plant at Crested Butte, Colo. Recently it was sold at sheriff's sale to satisfy debts he incurred. One of the organizers, formerly a man of some means, is said to have died of grief on Feb. 8, 1938, because he had lost all his money and had been blamed by Dr. Williams for the failure of this project. The books and records of the Electronic Pure Metals, Inc. were left in Sheffield as security for the unpaid hotel bill.

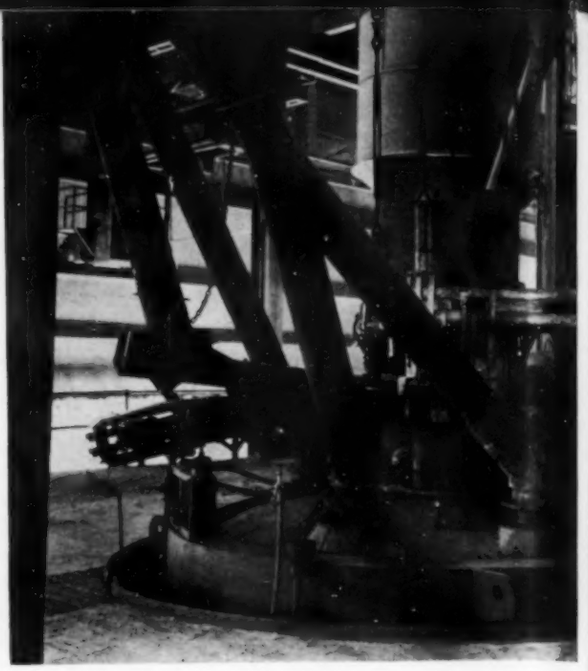
Chemical and metallurgical engineers who learn of further promotional activities of Glen Lenardo Williams will be doing a service to their profession if they will bring the information to the attention of such agencies as the Better Business Bureaus. If information on his previous record and various disastrous promotions is desired, *Chem. & Met.* will be glad to make available to any responsible investigator its complete file of pertinent data.

E.C.P.D. IN PERSPECTIVE

NOWHERE have we seen a better statement of the functions, purpose and opportunity of the Engineers' Council for Professional Development than this:

> The challenge to the Engineers of Today is to assure better Engineers Tomorrow. We vision what engineering may contribute to the life of the future, through technical service, through management of engineering and industrial projects, and through aid in technical, social and economic adjustment. The realization depends on the engineers of the future—those who are now in the making. Concerned with their training are many organizations; E.C.P.D. is a great culminating conception; it is by them designated to "enhance the professional status of the engineer through their cooperative support." A magnificent opportunity; a gigantic responsibility; to think, to plan, to propose, to act, through cooperation of existing organized engineering societies.

This is Chairman Charles F. Scott's preamble to the fifth annual report of E.C.P.D. which has just been published. In keeping with the high purpose so well expressed, his report is a stimulating contribution that should be read and studied by all engineers interested in professional progress.



The Tennessee Valley Authority's plant for the production of phosphoric acid and superphosphate by the electric furnace method has been described in three previous articles[1,2,3] published in *Chem. & Met.* A fourth article[4] in the series gave a detailed estimate of the cost of producing a concentrated superphosphate by this process. Now, with the plant well along in its fourth year, the authors present some further observations on electric furnace practice. In a similar article next month they will discuss some changes in the acid plant.

T. V. A. Reviews Its Experience in PHOSPHATE SMELTING

By H. A. CURTIS, A. M. MILLER and R. H. NEWTON

TENNESSEE VALLEY AUTHORITY, WILSON DAM, ALABAMA

THREE ELECTRIC FURNACES for phosphate smelting have now been built and operated at the T.V.A. phosphoric acid plant; a fourth has been designed and is under construction. Furnaces No. 1, No. 3, and No. 4 are rectangular, while No. 2 is cylindrical. There are inherent advantages in each of the two shapes used, so that neither is greatly superior to the other. The following comparisons bring out the advantages and disadvantages of each:

There are no buckstays on the cylindrical furnace. This gives better opportunity for water-cooling the steel shell. Also, when a "tap-out" occurs in operation, it is easier to cut out a section of the shell, repair the lining and weld a patch on the shell.

The amounts of both steel and refractories are less in a cylindrical furnace crucible than in a rectangular one of the same capacity. As against this, the carbon used in the lining of the rectangular furnace requires less cutting and less waste in preparing suitable shapes.

The removable top of a cylindrical furnace requires heavy, special refractory shapes, which are costly. On the other hand, very little steel is required as compared with that used in the roof of a rectangular furnace, and the total weight of the removable roof is less for the cylindrical furnace than for the rectangular one.

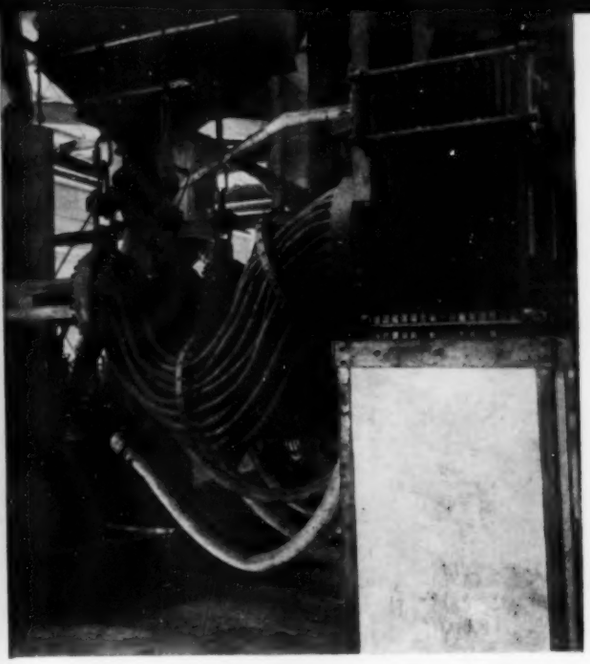
The absence of steel members on the removable roof of a cylindrical furnace avoids entirely the electrical problems encountered on the roof of the rectangular furnace where the steel supports are in the neighborhood of conductors carrying heavy electrical currents.

The chief advantages of the rectangular furnace over the cylindrical, lie in the fact that the former permits a simpler and better arrangement of electrodes, electrode suspension system, feed bins and feed chutes, gas offtake, and poke holes. Electrode guides to hold the electrodes in vertical alignment and proper location are also feasible on a rectangular furnace, but not a cylindrical one.

It might be thought that the triangular spacing of electrodes in a cylindrical furnace would permit a better electrical balance. This does not prove to be the case, however, for although the symmetry with respect to the furnace is good, the electrical connections from the electrodes to the delta at the transformers are of uneven lengths. The flexible copper cables carrying the current to the electrodes are closer together on the cylindrical furnace than on the rectangular, and therefore react on one another to a greater degree. This fact, and the absence of structural steel on the roof of the cylindrical furnace, results in a slightly better power factor for this type of furnace, i.e., 0.88 to 0.90 for the cylindrical as compared with 0.86 to 0.88 for the rectangular furnace.

There are fewer feed chutes used on the cylindrical furnace; in fact, there is too little room in the roof of the cylindrical furnace for the desirable number of feed chutes. This results in a poor distribution of charge as compared with that which can be obtained with the larger number of feed chutes used on the rectangular furnace. It is not feasible to feed furnace charge to the middle of the cylindrical furnace roof by means of a chute for the reason that the feed chute would interfere with new electrode sections brought in by the crane as needed. For this reason a nearly horizontal vibrating feeder, more expensive than a feed chute, must be used to bring the charge to the center of the cylindrical roof.

The gas offtake of a phosphate smelting furnace must be large, and is preferably located on the furnace roof. The



Roof of Electric Furnace No. 2, cylindrical, showing electrodes, poke holes, feed chutes and gas offtake

limited space available on the roof of a cylindrical furnace is a handicap, and, since no feed chute can be located in the area occupied by the offtake, there is an undesirably shallow charge in the furnace under the offtake.

In the cylindrical furnace, there is a high temperature area within the triangle formed by the electrodes. The charge melts down faster within this area than around the electrodes; the new charge feeding down tends to push the electrodes out of plumb and this makes it somewhat more difficult to keep the electrode seal rings packed effectively.

The necessary crowding of electrodes, feed chutes, poke holes and gas offtake on the roof of the cylindrical furnace gives less favorable working conditions in maintaining electrode seals, adding new lengths of electrode, poking the burden, etc., than encountered with the rectangular furnace.

All things considered, the rectangular furnace appears to be somewhat preferable, but it may be said that both shapes give satisfactory service. It is fundamental in furnace design, regardless of furnace shape, that the roof be made easily removable. The furnace must be relined below the slag line about once a year. The removable top saves time on this job, and, more important, permits better working conditions whenever the furnace must be cleaned out and relined.

Furnace Tap Holes, Linings and Electrodes

In furnaces No. 1 and No. 2, as originally built and operated, two tap holes at slightly different levels were provided, with the idea that the ferrophos might be tapped from the lower hole and slag from the upper. It was soon found, however, that the ferrophos and slag did not stratify sufficiently to be drawn off separately. The second tap hole was therefore eliminated.

Originally the tap hole was made cylindrical, horizontal, and about 3 in. in diameter. It was found that such a tap hole was difficult to plug after tapping. At present the tap hole is tapered from a diameter of 3 in. at the inside of the furnace wall to a diameter of 7 in. at the outside of the wall. The bottom of the hole is horizontal and at the level of the furnace floor. The tap hole block is cut from a solid piece of carbon. Originally, this was extended out through the furnace wall, the outer end forming the slag spout. Later, the tapping block was cut so as to extend only through the furnace wall and a separate tapping spout used. The life of the carbon tap hole block is about the same as that of the furnace lining. The tapping spout has been redesigned several times. At present a water-cooled cast iron trough is used. This is lined on the sides with Carbofrax and on the bottom with a tamped carbon paste. The tapping spout may be repaired easily in place, or may be replaced without interrupting furnace operation.

As mentioned in an earlier paper, both continuous and intermittent tapping of the electric furnaces have been tried. The continuous tapping lowered the furnace wall temperatures, which was advantageous, but the difficulty of maintaining the tapping spout, and the trouble with arching and crust formation in the furnace charge made it evident that intermittent tapping was preferable.

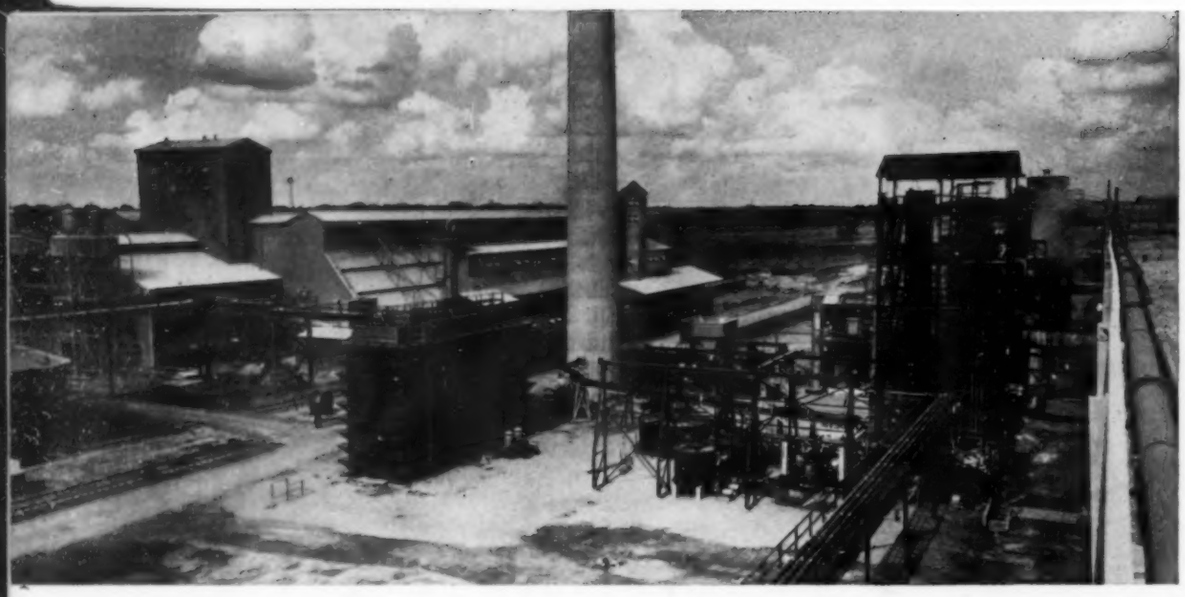
As indicated in earlier papers, the electric furnaces are lined with high-alumina brick from the top edge down to a point a foot or so above the slag line. There is practically no deterioration of this part of the lining. The floor of the crucible and the sides up to a foot or so above the slag line are lined with carbon blocks. For most of the linings, the carbon blocks were cut from old carbide furnace electrodes purchased for the cyanamide plant in 1918. As an experiment, dense carbon blocks were purchased for lining one of the furnaces. The dense carbon blocks did not give appreciably longer service than the old electrodes.

Various methods of making up the joints between the carbon blocks have been tried, but no great advantage of one method over another was revealed. At present the blocks are laid up with clearances of about 1½ in. at the joints and the joints then filled with hot carbon paste rammed in with an air hammer. There appears to be no advantage in planing the blocks so as to get close fitting at the joints and it is much cheaper to use rammed joints.

Electrode breakage, which was a troublesome problem in the early months of operation, has become a negligible source of trouble. Skill in making up electrode joints, good distribution of furnace burden, water-cooled glands around the electrodes where they enter the furnace, and limiting the current density to about 28 amperes per square inch have brought about the improvement. Better control of the gas pressures in the furnace, with consequent lessening of air leakage at the glands, has also helped to eliminate electrode breakage.

In making up electrode joints, it is desirable to use a dense and highly conductive carbon for the threaded pin. Good electrical contact between the pin and the electrodes is had by impregnating the pin with a tarry compound. When the pin gets hot, the tar is exuded and carbonized between the threads of the pin and electrode, the coke thus formed serving to reduce materially the electrical resistance otherwise set up by poor contact in the threads.

All of the rectangular furnaces have been fitted with semi-rigid electrode guides. These help to keep the electrodes plumb and centered in the water-cooled glands. The guides are not absolutely essential, however, for on



General view of Acid Plant No. 3 and Superphosphate Manufacturing Plant

the cylindrical furnace the electrodes are suspended on steel cables.

Furnace Charge

Several kinds of raw phosphate have been tried in the electric furnaces, including lump brown rock, lump blue rock, and lump white rock; pebble rock; nodulized phosphate sand; nodulized phosphate muck; and sintered phosphate muck. All of these materials were used successfully, so far as furnace operation was concerned, but, as noted elsewhere in this paper, some of the difficulties encountered in operation of other parts of the plant were related directly to the character of the furnace charge.

The raw phosphate must, in any case, be in lump form. Material passing a 2-in. screen and rejected by a 4-mesh screen will ordinarily be satisfactory, but there must not be too large a proportion of the smaller sizes. Most of the gas is generated near the bottom of the furnace, and must find its way up through the charge. If there be too large a proportion of small material, not only is the resistance to gas flow through the charge increased, but there is a tendency for the fine material to fuse and arch above the slag pool. Gas pressure then increases until it is sufficient to break through the obstruction, thus causing "puffs" or "blows" in the furnace.

A dusty furnace charge will necessarily increase the amount of dust carried out with the gases leaving the furnace. This dust is picked up in the phosphorus condensing system, and contributes to the "dirty phosphorus" problem. However, as will be noted elsewhere in this paper, the dust carried out of the furnace is by no means the principal cause of the sludge which causes difficulty in the phosphorus collecting system and the acid plant.

When smelting any material other than sintered or nodulized muck, it is necessary to add silica pebble as a flux for the phosphate charged. Rock phosphates carry more or less silica. Additional silica pebble is added to give a lime-silica mol ratio in the charge of about 1.26. Ratios from .86 to 1.53 have been tried. Obviously, it is desirable economically to add as little silica as possible, i.e., to keep as large a lime to silica mol ratio as is feasible. The 1.26 ratio has been found the most generally satisfactory.

The alumina in rock phosphate also serves as a flux, but in lump rock or in nodules made from washed phosphate sand the alumina is so low (usually less than 3 per cent) that it may be disregarded in calculating the additional silica required. In the sintered or nodulized muck, however, the alumina content is much higher and should be taken into account. In fact, in the several varieties of brown phosphate muck used so far in sintered or nodulized form, the silica and alumina present are usually sufficient for fluxing and then no silica is added to the charge.

In the following table typical analyses are given for the several kinds of phosphatic materials used as furnace charge:

Typical Analyses of Phosphatic Materials as Used in Furnaces (Per Cent)

	Brown Rock	Blue Rock	White Rock	Florida Pebble	Nodulized Washed Sand	Nodulized Muck	Sintered Muck
P_2O_5	32.8	27.8	30.2	32.0	32.6	24.5	24.3
CaO	46.8	40.7	43.4	47.8	45.4	33.5	35.3
SiO_2	7.8	11.3	13.9	5.9	13.0	24.5	23.4
Fe_2O_3	3.3	6.4	3.4	1.7	3.7	6.0	2.3
FeO	0	0.7	0	0	0	0	3.2
CO_2	1.6	1.8	2.0	3.3	0	0	0
H_2O	2.2	0	0.9	0	0	0.1	0
C	0	0	0	0	0	0	1.4
Al_2O_3	2.5	1.6	1.0	1.3	1.9	9.0	6.7
F	3.5	3.3	3.1	3.6	2.6	2.1	2.3
K_2O	0.5	0	0.4	0.2	0.4	1.3	1.0
S	....	5.3	....	....	....	....	....

Note: Inasmuch as the compounds occurring in the phosphatic materials are not those appearing in the above table of analytical data, the analytical figures should not add to 100 per cent.

Coke breeze is a satisfactory reducing agent for use in an electric furnace. Breeze from which the finer fractions have been screened gives a little cleaner furnace gas and fewer "puffs" in the furnace. Several methods of calculating the coke required for a given charge have been used. Current practice is to use sufficient coke to furnish the fixed carbon required to reduce all the P_2O_5, Fe_2O_3 and CO_2, and one-half the H_2O in the phosphate. The fraction of the total moisture actually reduced varies with furnace conditions, one-half being taken as an average.

For some of the materials listed above, furnace charges would be made up as follows:

	Brown Rock	White Rock	Nodulized Sand	Nodulized Muck	Sintered Muck
Phosphate	2,000	2,000	2,000	2,000	2,000
Silica pebble (97.9 SiO_2)..	654	478	523	0	0
Coke (83 per cent F.C.)...	381	346	340	282	239

Solution of the problem of the most economical grade of phosphate to be used in an electric furnace is possible if the analyses of the phosphate, coke, and silica pebble are available, and their costs as delivered at the furnace known. For at constant load the total electrical energy required per pound of P_2O_5 volatized is a linear function of the P_2O_5 content of the furnace charge exclusive of coke.

Nodulizing Phosphate Sand or Muck

In the early months of operating the T.V.A. Fertilizer Works, natural lump phosphate was used in the electric furnaces. In crushing the lumps to sizes suitable for furnace use, in drying the lumps, and in otherwise preparing the material for furnace use, a considerable proportion of the lump material was degraded to sizes too small for electric furnace charge. This fine material was ground and used with phosphoric acid in making superphosphate of about 43 per cent available P_2O_5. More fine material was produced than had been anticipated, however, and there accumulated at the plant several thousand tons of fines more than could be used in the superphosphate plant. It was then decided to try nodulizing the fines in one of the old lime kilns of Nitrate Plant No. 2 and in this manner produce a material suitable for use in the electric furnace. Equipment for oil-firing one of the kilns and for feeding the fines to the kiln was installed. At a temperature of about 2,400 deg. F. the fines nodulized readily. The discharged nodules were cooled, crushed, and the smaller sizes (10 mesh) screened out. This product proved to be an excellent furnace charge. A kiln 7½ ft. in diameter and 125 ft. long has been operated to produce about 100 tons of nodules per day, with an oil consumption of about 40 gal. per ton of screened nodules produced. It is believed that larger capacity and lower oil consumption will be obtained with further experience in nodulizing.

Many thousands of tons of nodules have now been made from phosphate fines, washed phosphate sand, and several types of phosphate muck. (Muck or matrix is the term applied to raw phosphate as mined. It usually carries a few per cent of small plates of phosphate, but is mostly a brown mud made up of phosphate grains, clay, etc.) It is estimated that nodulizing phosphate muck in a coal-fired kiln would be at least as cheap, and probably a little cheaper, than sintering the muck in a standard sintering machine.

In the mining of phosphate muck it is possible to separate roughly the mined material into a higher and a lower grade material. If, for example, a sintered or nodulized product carrying about 24 per cent P_2O_5 be desired for furnace use, it is possible to send directly to the sintering or nodulizing plant from 40 to 60 per cent of the muck mined from some of the better deposits in middle Tennessee. The lower grade muck may then be washed to yield a sand carrying 24 per cent P_2O_5 or higher, and this product then sintered, or mixed with the unwashed muck and sintered.

In this way, not only is the cost of washing avoided on a considerable part of the muck mined, but the loss of phosphate incident to washing is also avoided. Inasmuch as an ordinary washing plant wastes from 30 to 50 per cent of all the phosphate mined, it is seen that there is a substantial saving and a conservation of phosphate in sintering or nodulizing directly as large a fraction of the muck as may be permissible.

Electric Furnace Slag

Slag is tapped from the furnaces into heavy cast-iron chill cars each holding about 2½ tons. The slag cools very slowly in these cars. When a low alumina rock phosphate is used in the furnace charge, the cold slag is gray in color, and crystalline, looking very much like limestone. Crushed and screened to appropriate sizes, it may be used for road construction, concrete aggregate, etc. Inasmuch as it must compete with crushed limestone, its distribution radius is limited, and in most locations it probably will not be worth while to set up a crushing and screening plant to serve the market available within economic shipping distance of the plant.

It has been demonstrated that the calcium in the slag

Phosphoric Acid Plant No. 3, showing phosphorus vaporizer at the left; burner, packed absorption tower and three tubular gas coolers center

is readily available to growing vegetation and is equivalent to the calcium in limestone as a soil conditioner. The fines produced in a slag crushing and screening plant, or electric furnace slag from a quenching system, may therefore be used as a substitute for limestone in agriculture. In actual comparative tests, a better result is nearly always obtained with ground slag than with ground limestone, presumably indicating that the silica of the slag and possibly the small amount of P_2O_5 present may have a beneficial effect. The ground slag, however, should not be mixed with superphosphate in use, for although there is little or no reaction in a dry mixture, the presence of moisture causes loss of phosphate availability[5,6]. This undesirable result may be avoided by mixing the ground slag with the soil prior to the application of superphosphate.

When a high alumina phosphate is used in the furnace charge, such as sintered phosphate muck carrying 8 to 10 per cent Al_2O_3, the slag obtained cools to a dark glassy material resembling ordinary blast furnace slag.

Ferrophosphorus

More than 90 per cent of all the iron in the furnace charge is reduced to metallic iron during the smelting of the phosphate. This iron absorbs elemental phosphorus, together with small proportions of manganese, silicon, etc., forming a material known commercially as "ferrophos."

Most of the ferrophos settles out of the molten slag tapped from the furnace, and may eventually be recovered by simple means. Some of the ferrophos, however, is dispersed in fine droplets in the slag and does not settle out as the slag cools. The actual recovery of ferrophos in marketable form varies from 65 per cent to 85 per cent of the theoretical under the present method of collection.

A typical partial analysis of the ferrophos as marketed is:

	Per Cent
Phosphorus	25.5
Manganese	2.4
Sulphur	0.7

The market price for ferrophos has varied from $75 to $85 per gross ton for material carrying 24 per cent phosphorus, with a credit of $3 for each per cent above 24 per cent. At the lower market price ferrophos of 24.5 per cent phosphorus content would sell for $79.50 per long ton. It will be noted that at this price the phosphorus in ferrophos brings $121.50 per net ton of P_2O_5 equivalent, whereas available P_2O_5 in concentrated superphosphate sells at about $75 per net ton after several additional costs have been incurred. It is therefore advantageous to make as much ferrophos as the market will absorb. The production of ferrophos may be increased at will by merely adding scrap iron or iron ore to the furnace charge. In the T.V.A. operations no ferrophos has actually been made beyond that necessarily resulting from the smelting of phosphate. The byproduct ferrophos is sold from time to time in small lots to the highest bidder.

Heat and Material Balances

Detailed heat and material balances for an electric furnace smelting rock phosphate will be presented in a subsequent paper. The following is a summary of a typical heat balance.

The major reactions in an electric furnace operating on such a charge as has been indicated may be represented, as an approximation, by the following equations:

$$2\ Ca_3(PO_4)_2 + 10\ C \longrightarrow 6\ CaO + P_4 + 10\ CO \quad (1)$$

$$X\ CaO + Y\ SiO_2 \longrightarrow (X - Y)\ Ca_3Si_2O_7 + (3Y - 2X)\ CaSiO_3 \quad (2)$$

The overall reaction is endothermic, and the heat required decreases as the lime-silica ratio decreases. With a lime-silica mol ratio of 1.43 the theoretical requirement is 9,660 B.t.u. per pound of phosphorus formed, while with a lime-silica mol ratio of 1.26 the theoretical requirement is 9,304 B.t.u. per pound of phosphorus.

The above theoretical heat requirements are only approximately correct, for rock phosphate is not $Ca_3(PO_4)_2$; nor is all the phosphorus reduced, some remaining in the slag; nor is all the phosphorus formed volatilized from the furnace, some of it dissolving in iron to form ferrophos; and there are numerous side reactions, such as reduction of iron oxide and liberation of fluorine compounds.

Aside from the heat required for the chemical reactions, there are heat losses from the outside of the furnace and in the products coming from the furnace. In all, it requires from 22,000 to 23,800 B.t.u. to volatilize a pound of phosphorus. A typical distribution of this heat consumption is as follows:

Power input per pound phosphorus volatilized....22,300 B.t.u.
Heat output

	B.t.u.	Per Cent
Major reaction	9,300	41.7
Side reactions	1,340	6.0
Sensible heat in products	7,135	32.0
Heat losses	4,525	20.3
Total	22,300	100.0

The following is given as a typical material balance on an electric furnace:
Input

	Tons Per Month
Phosphate sinter or nodules	2,646
Coke	330
Total	2,976

Output

Slag	1,996
Ferrophos	139
Phosphorus	229
Other gases, almost entirely CO (by diff.)	612
Total	2,976

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Vacuum Pressing Makes Stronger, Denser Refactory Brick

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Stacking vacuum-pressed refractory brick on a kiln car

IN MANUFACTURING machine-made brick, two methods are in common use. One is the extrusion process, the other the power-press process. Within recent years, the vacuum principle has been successfully applied to both. Vacuum technique, as applied to the extrusion process, is termed de-airing; as applied to the power-press process, it is termed vacuum pressing. Some idea of its commercial importance is afforded by the fact that Harbison-Walker Refractories Co. applies the vacuum principle in forming blast furnace brick, regenerator checkers, recuperator and regenerator tile, runner brick, and acidproof brick. In fact, all power-pressed brick made by that company for use in blast furnace linings are formed under a high vacuum.

In the extrusion process, the various clays used for the brick batch are first ground, screened and mixed in proper proportions, with sufficient water to form a stiff plastic mass. Blending and tempering are usually accomplished in a mixer of the type known in the ceramic industry as a "pug mill."

In its simplest form, the pug mill consists of a steel trough, usually about 12 ft. long, provided with a power driven steel shaft running lengthwise of the trough. Upon the shaft are attached a large number of steel knives set at an angle. Frequently, the mill has two shafts which rotate in opposite directions. The ground clays are introduced at one end of the pug mill, sprayed with water, mixed and kneaded and carried through the mill by the action of the knives, and then discharged continuously from the opposite end. The tempered mixture drops into an auger machine, from which it is extruded through a lubricated die in the form of a column. The clay column is cut transversely into individual brick by means of the wires of an automatic cutter and the brick repressed in a power driven press, or by hand. The purpose of this operation is to develop sharp corners and edges and smooth surfaces, and to imprint the brand name. Finally, the brick are dried and then fired.

The extrusion process in its customary form has certain limitations, when used for the manufacture of brick intended for service in which accuracy of dimensions, uniformity of structure and freedom from internal laminations are of special importance. Internal weakness may result from the "slicking" effect of the revolving auger upon the wet clay, and the subsequent non-uniform rate of flow of the clay through the die. Since the slicked surfaces are likely to be separated by thin films of entrapped air, they may not knit together properly. They tend to slip over each other, causing laminations which may later show up as imperfections in the burned brick.

Advent of De-airing

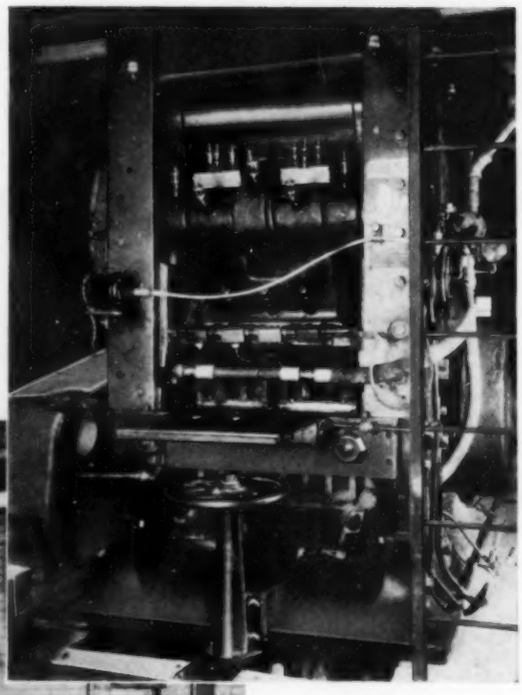
As a means of reducing the disadvantageous effects of entrapped air, de-airing of the clay batch has become familiar practice in connection with the extrusion process during the past five years. Several commercial units employing the vacuum principle are now available. Generally, in this equipment, the batch after having been blended and tempered in a mixer, is forced into a vacuum chamber, through a "sealing die." While passing through openings in the die, the clay is divided into a number of small continuous ribbons. In the vacuum chamber these ribbons are cut into extremely small pieces and the air extracted. Then, by means of an auger, the de-aired clay is forced through an extrusion die, in which a column is formed. Since there is no air present to separate the slicked surfaces produced by the auger, these surfaces tend to knit together as the batch passes through the die. The use of de-airing equipment has brought about definite improvement in brick produced by the extrusion

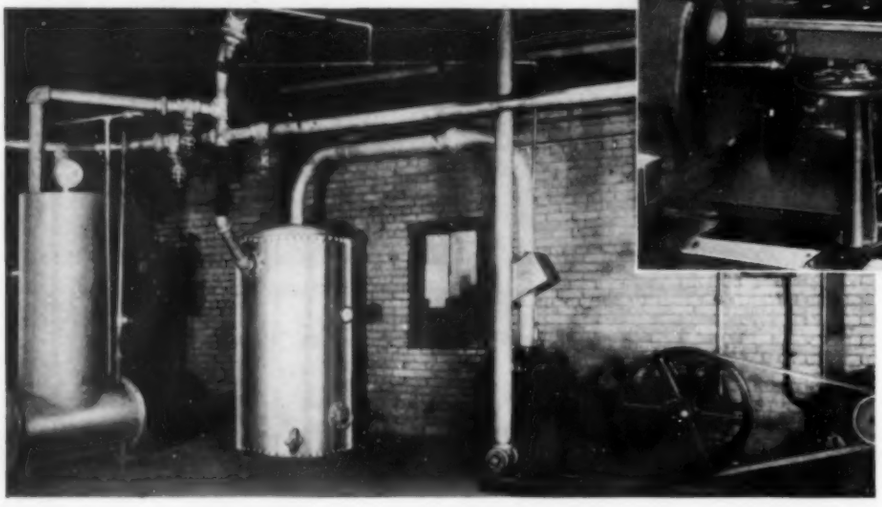
process. De-airing renders the clay more workable, decreases the tendency toward lamination during manufacture, and increases the density of the finished brick.

De-airing is used in the refractories industry for the manufacture of recuperator and regenerator tile, runner brick, and acidproof brick. It is also employed by the makers of face brick, hollow tile, chemical stoneware, and similar articles.

Power Pressing

In the manufacture of power-pressed brick, ground clays are screened to the desired size, blended and thoroughly mixed with a small quantity of water. The moistened batch, which has a consistency very much like that of damp molding sand, is fed to a mechanically operated press in which the brick are formed at high pressures. Toggle presses, of which a common type is illustrated in this article, are most commonly used. The clay in loose condition is charged into the press molds and compressed by the force exerted by top and bottom plungers, which move toward each other within the mold box. After the brick is formed, the pressure is removed and the bottom plunger continues its movement to eject the pressed brick from the mold.





Above — Power press showing vacuum connections to plunger dies

Left—Vacuum pump, vacuum tank and special air washer

The power-press process was recognized as a desirable one many years ago, but its adoption to any considerable extent was delayed chiefly because the fundamental principles governing its application were not clearly understood. As these difficulties were gradually overcome through plant research, power-pressed brick came into favor. Since in manufacture they are subject to no appreciable drying shrinkage and to only a slight firing shrinkage, they can be made with minimum deviation from desired dimensions. Being hard and dense, even when first pressed, they are not readily deformed through handling previous to firing. Finally, this process is especially well adapted for use in combination with the tunnel kiln method of firing, since the brick as pressed can be set directly on the tunnel kiln cars.

In service, the resistance of refractories to abrasion and to penetration by corrosive slags, and their load carrying capacity and degree of stability in volume at high temperatures, generally increase with increasing bulk density. It has been recognized, therefore, that if power-pressed brick could be made more dense by the application of higher molding pressures, they would have greater utility for certain service conditions. In practice, however, a serious limitation existed which made higher pressures impracticable, notwithstanding the fact that the presses could be operated at these higher pressures. Above a certain critical point, pressure cracks would develop in the brick to such an extent that loss in manufacture was excessive.

How Cracks Form

The reason for the formation of the pressure cracks during the pressing operation is apparent when it is realized that the volume of the pressed brick is only about half that of the loose clay charged into the press box, so that initially 50 per cent of the mold is occupied by air. When the top plunger enters the mold, any trapped air is compressed along with the clay. However, compression of the clay takes place first at the very point where air must escape from the mold, thus partially sealing off the air, preventing its escape, and forcing it toward the center of the mold under increasingly higher pressures. Then, as the plunger pressure is released, expansion of the entrapped air may actually split the brick open, with the formation of numerous small cracks radiating outward in all directions from the center. Other cracks may form approximately parallel to the

face of the plunger. Frequently, as the brick come from the press, the pressure cracks are merely lines of weakness, rather than visible fractures, and are not revealed until after firing. Vent holes provided in the mold box to relieve the air pressure will only partially overcome the difficulty, because the air becomes entrapped within the brick. By slowing down the time of the pressing cycle to as little as one-third of normal, the air is given a better chance to escape, and therefore a somewhat denser brick can be made. However, this is a compromise, rather than a solution of the problem.

In theory, the solution seems obvious. All that need be done is to evacuate the air from the loose clay in the mold chamber, just prior to compression, so that it cannot be entrapped within the brick. In practice, this procedure was found to present such difficulties that from time to time several other methods of accomplishing the same purpose have received consideration by investigators. One of these methods employed a double pressing cycle. The clay with its entrapped air was compressed on the first stage of the cycle. The pressure was then released, permitting the escape of entrapped air, with the formation of cracks. Renewed application of pressure in the second stage of the operation, presumably knitted the clay together again. In another method, the air in the charge was displaced by a gas which subsequently was either absorbed by the clay, or condensed as a result of the application of pressure.

Practical Vacuum Pressing

Vacuum pressing as a method of forming is an example of a simple and obvious idea which became commercially practicable only after a large number of secondary difficulties had been overcome. It is, therefore, interesting not only from the standpoint of its effect upon the properties of the brick produced, but also from the standpoint of the development of a process. Final success in bringing vacuum pressing to a practical commercial basis was achieved by a combination of steps which included both the design of special equipment and a modification of operating procedure. First of all, plunger die plates with numerous evacuation vents of a unique shape were designed. These vent holes in the faces of the plungers which come in contact with the clay are short and tapered, and of extremely small cross section. In operation, the small clay particles carried along with the air which is evacuated can readily pass through the vents without clogging or closing them. Connected with the vents are evacuation channels of sufficiently large cross section to permit unrestricted passage of air and dust.

At normal operating speeds, a complete pressing cycle requires about six seconds. Of this time, less than a second is available for complete evacuation, for as soon as compression of the charge begins, a seal against further escape of air is formed. The vacuum is applied at the instant the plunger enters the mold box, but before the charge is appreciably compressed.

Practically complete removal of the air in the brief space of time available is accomplished by what might be called "flash evacuation." This is made possible by connecting the press mold with a vacuum tank. The connecting passages are large, and the tank has a volume about 50 times that of the press box. A vacuum equivalent to 28 in. of mercury is maintained in the tank. At the proper stage in the pressing cycle, the tank is connected instantly with the evacuation passages in the plungers. This is accomplished by means of a timed valve actuated by a cam on the press. At the instant the vacuum becomes effective, a swift rush of air from the mold occurs, and this sweeps with it any dust that might otherwise settle in the passages. A vacuum pumping system with a capacity of about 50 to 75 cu.ft. per minute per press is required to maintain the proper vacuum in the tank.

Troubles With Dust

Further difficulties in making this process a practical one arose from the fact that the air leaving the molds is laden with damp, finely divided dust, which tends to settle and build up in vacuum passages, valves and vacuum pumps. Any condensation of moisture in the vacuum lines aggravates the situation.

Nearly every standard type of valve was tried, but they either wore out rapidly, or they failed to function because of the dust which built up on the seats. Finally, a specially designed piston-type valve with a soft rubber disk was adopted with satisfactory results. Ordinary dry air filters became filled with dust so rapidly that it was necessary to design a special air washer. In this unit, the dust-laden air is ejected under water, through very small openings. The air loses its dust before it reaches the surface of the water, from which point it passes on into the pump or ejector. As much as 100 lb. of mud is drawn from one of these filters after 8 hours of operation. In some cases, electric unit heaters have been installed on the vacuum lines to prevent condensation.

Under the evacuation system finally developed, the forming pressures are approximately double those formerly practicable. At these higher pressures, the weight of the brick is increased as much as 5 per cent and its porosity reduced about one-fourth. The load-bearing capacity at high temperatures and resistance to abrasion are improved, and penetration by slags is reduced. Since the brick are heavier, they have a higher capacity for the storage of heat, and are therefore especially suitable for use as checker brick in regenerators.

Naturally, adoption of vacuum pressing adds materially to both direct and indirect costs of manufacture. A considerable investment is necessary for vacuum pump, filters and other equipment for each press, and additional maintenance is needed for this equipment. Vacuum dies wear out much faster, owing to the higher pressures under which they are operated. More clay is used per brick, more power is needed for pressing and evacuation, and more fuel is required for firing.

At the present time, vacuum-pressed fireclay brick are being supplied from four Harbison-Walker plants for service in which the greatest advantages are to be expected from their use, such as in blast furnace linings, in regenerator checkers, and in other service for which brick of special density are desired. Vacuum-pressed acidproof brick for chemical applications are supplied also. Naturally, many of these applications are such that actual proof of increased length of service can be obtained only after several years use of the brick. The full extent to which adoption of vacuum pressing is economically justified will be demonstrated gradually by experience. However, it seems safe to say that for certain service conditions the advantages gained by applying the vacuum principle to the power-press process will be considerable.

Large coke oven plant of Società Montecatini at San Giuseppe, Italy, where 120 metric tons of nitrogen is produced daily in the form of nitric acid and synthetic ammonia

Italian Chemical Industry Turns

AN EDITORIAL INTERVIEW

Dr. Ing. Giacomo Fauser, famed for his chemical engineering achievements (notably his processes for synthetic ammonia, nitric and contact sulphuric acids), was a United States visitor last month in search of new equipment and technical information to take back to Italy. As a result of an interesting interview with him, the editors of *Chem. & Met.* are able to present some highlights on recent developments and trends in Italian chemical industry. Dr. Fauser hardly needs an introduction to American chemical engineers (see *Chem. & Met.* 35, 1928, pp. 474–8, *et seq.*), but perhaps is it not generally known here that last December he was granted the Honorary Degree of Doctor of Technical Science by the Swiss Institute of Technology in Zurich.—Editor.

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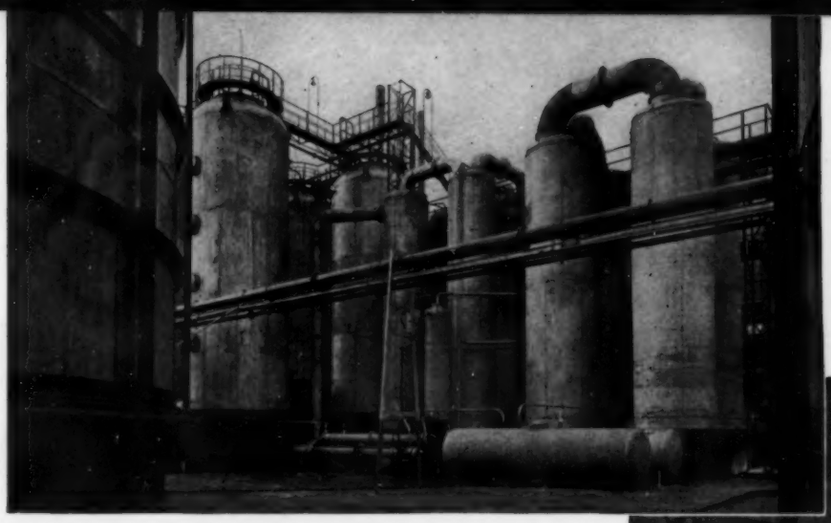
IN ITALY the course of chemical industry as well as that of all other industries, is now more than ever closely controlled and carefully guided by the State under the auspices of the Central Corporative Committee. The industry is forced to adopt a closed economy—an autarchy, substituting domestic products for imports wherever possible to conserve foreign exchange. This system certainly has the advantage of stimulating research and technical development.

Fuel—According to Dr. Fauser a real problem exists in connection with Italy's fuel supply. Over 90 per cent of her coal must be imported because she has only a low-grade lignite. Most of the 500,000 metric tons (about 200,000,000 U.S. gal.) of gasoline and 100,000 metric tons of lubricating oil consumed annually by automotive engines must also be imported. To effect a saving the government has stipulated that all gasoline must contain at least 20 per cent of fuel alcohol. This means a production for 1938 of 100,000 metric tons (approx. 32,000,000 wi. gal.) of alcohol, at least 98 per cent of which will come from sugar beets. Another 20- to 30,000 tons of gasoline will be replaced by carburants such as methane, of which there are large domestic sources.

Hydrogenation of fuels is advancing rapidly. The National Agency for Hydrogenation of Fuels has two important works under construction at Bari and Livorno which should begin operations near the end of the year with a production of 250,000 metric tons (100,000,000 gal.) of gasoline, of which 100,000 tons will be high-octane for airplanes, and 60,000 tons of lubricant. Crude oil from Italian concessions in Albania will provide raw material at first, and later domestic lignites and Sicilian shale oils will be hydrogenated.

Fertilizers—Questioned about the Italian fertilizer industry, Dr. Fauser stated that nitrogen consumption especially was increasing rapidly with gratifying results. In 1937, 100,000 metric tons was consumed in the "Battle of Grain" as compared with 30,000 tons in 1925, the year this program was initiated by Il Duce. The nitrogen industry of the country is equipped to supply all industrial and agricultural needs. It has an installed cyanamide capacity of 30,000 metric tons of nitrogen, and synthetic ammonia capacity of more than 110,000 tons. Società Montecatini, which uses the Fauser process, controls 70 per cent of this synthetic ammonia production, the rest being divided among several companies, some using the process developed here by the Nitrogen Engineering Co. Fifty-five per cent of the hydrogen necessary for synthesis is obtained by electrolysis, the rest from coke ovens.

The latest and most important coke oven plant is at San Giuseppe near Savona and is owned by the Società



Stainless steel absorption towers for production of nitric acid from ammonia at San Giuseppe, Italy

Below—Part of a battery of converters for oxidation of ammonia to nitric acid by the Fauser process as installed in the plant shown on the opposite page. A flowsheet for this process may be found in *Chem. & Met.*, 37, 1930, p. 607. The lower photo shows the cell room of the Montecatini aluminum plant at Bolzano, which started operations last year and is said to be the last word in modern aluminum production

to Autarchy

Montecatini. Pictures of it may be found above. Nitric acid is made there by the Fauser process described in *Chem. & Met.*, **37**, 1930, pp. 604-8. At present the capacity of the plant is 120 metric tons of nitrogen per day (one unit makes 330 tons of nitric acid per day), but in June it will be increased to 170 tons.

Phosphates are made from North African phosphate rock by the sulphuric acid process. With the exception of one plant at Crotone, which makes ammonium phosphate, the entire production is in the form of superphosphate. Potash is imported from Germany. Very little Chile saltpetre is used; consequently, almost all nitrogen fertilizers come from the sources mentioned above.

Sulphuric Acid—Dr. Fauser states that the trend in Italy is toward production of an increasing proportion of sulphuric acid by the type of contact process developed by himself in preference to the chamber process although there is still a preponderance of chamber installations. Contact sulphuric acid is also made now as a byproduct of electrolytic zinc manufacture at the new works of the Società Montecatini at Mestre. Sufficient SO_2 results from combustion of the blend to yield 25,000 tons of acid for each 12,000 tons of zinc. Both pyrites and brimstone are found in Italy in abundance; so a source of raw materials for sulphuric acid entails little difficulty.

Aluminum—Dr. Fauser indicated that no report on the progress of Italian chemical industry would be quite complete without the story of aluminum. Production increased from 14,000 metric tons in 1936 to 20,000 tons in 1937 with the starting of the new Montecatini plant at Bolzano and is expected to reach 30,000 tons annually before long. A halftone of this new plant, claimed to include the latest developments in modern aluminum production, is shown herewith.

Blende roasters in the new plant of Società Montecatini at Mestre, Italy. Here 12,000 tons of electrolytic zinc is made yearly, and 25,000 tons of contact sulphuric acid is produced as a byproduct

Materials of Construction

Kraft pulp mills of the country are using a variety of materials for digester shells. Stainless steel is most generally used to prevent corrosion at the steam and liquor inlets and outlets on digesters. Right — Monel metal is most popular for the wire cloth of the thickeners although several mills prefer stainless steel

EDITORIAL STAFF REPORT

THE KRAFT PULP INDUSTRY of the country has been harassed by corrosion and abrasion throughout the mills. In an effort to overcome the troubles engineers have experimented with numerous different materials of construction. As a result many substitutions have been made which have added years of life to much of the equipment. This experience has been gathered together by means of questionnaires sent to the mill by the Materials of Construction Committee of the Technical Association of the Pulp and Paper Industry. A summary of the results was reported to the Association by James A. Lee, chairman of the Committee and managing editor of *Chemical & Metallurgical Engineering* at the annual meeting on February 24. A survey of the present practice was also recently made by the American Rolling Mill Co. John H. Founce, Jr. visited almost every kraft mill in the country and secured the information by interviewing engineers. He presented his finding at the same meeting.

The survey made by questionnaires shows conditions vary widely from one mill to another, and a material that might be satisfactory in a particular mill might not be suitable for the same purpose in some other mill.

A variety of materials are being used for digester shells. One steel plate shell has been in service 25 years without showing indications of pitting. A wrought steel shell is pitted but in use after 20 years. A fire box steel shell is not pitted after 12 years service. In another case a shell of rim steel boiler plate is pitted after 12 years although still in use.

Diffusers and wash pans had a life of as much as 30 years. A welded wrought iron diffuser holds the record for longevity but eight others have had a life of over 20 years. One has been in use 14 years and another 20 years without pitting. Corrosion has been most pronounced in false bottoms (four cases), but other authorities recorded weakness in: the lower half, lower third, sides about 10 ft. up, above liquor level, around rivets and at the top. Materials that have shown most resistance to pitting are: Monel, low carbon steel, stainless steel and wrought iron. Cast iron and cast steel are reported to pit badly.

In several cases steel or corrosion resistant metal perforated screens used in diffuser bottoms have given no trouble. One has pitted badly after 12 or 18 months, another has buckled, while one perforated steel bottom

for Kraft Pulp Mills

has lasted 6 years. Other troubles are cracking, holes enlarging, and general corrosion and abrasion.

Few mills profess to know which constituent of the liquor is most active in inducing pitting in digesters and diffusers but several attribute the trouble to polysulphides. Other factors that are mentioned include: sulphites, sulphides and organic constituents.

Metals that have been found to prevent corrosion at the steam and liquor inlets and outlets on digesters are: stainless steel (most popular) forged steel, mild steel, Ni-Resist, Monel, and cast iron; KA_2SMo trimmed valves are reported to be satisfactory. Double strength steel pipe is recommended by another mill. Two mills report no trouble.

Most mills report no corrosion trouble in digester sleeves, but two report wear. Two have found stainless steel best, while a third uses mild steel.

Steel tubes in indirect heaters are said to have lasted less than a year, brass tubes have had a life of 18 months KA_2Mo tubes have lasted 6 years, and two mills report stainless steel to be satisfactory. Several mills have been troubled by galvanic effects between corrosion resistant metal tubes and steel or iron shells and tube sheets. One finds this trouble is present only when bronze or brass is used in valves. Considerable trouble has been experienced with scaling. In fact, in one case, every material that has been tried has scaled badly and requires cleaning on the liquor side. Brass and steel tubes are said to give most trouble while two engineers report stainless steel to be best suited for the purpose. The several suggestions that were made to avoid or reduce scaling are : (1) well settled liquor should help, (2) clean tubes will assist, (3) holding causticity up and keeping SiO_2 and Al_2O_3 out of liquor, (4) clear white liquor, stock and rosin free black liquor, (5) lower SO_4 radical, (6) faster circulation.

Several mills that have had corrosion or abrasion trouble with digester circulating pumps have found the following metals most satisfactory: 30-10 and 18-8 stainless steels, KA_2SMo, KA_2Mo, dense semi-steel cast iron containing nickel and manganese, Ni-Resist. One mill reports the best material for castings to be 18-8 and for impellers and shafts 18-8 Mo, while another writes that nickel-iron shells and stainless steel shafts and impellers are best.

Eleven report stainless steel as the best material to resist corrosion in evaporator tubes. The life is said to be indefinite. One set of KA_2Mo tubes have operated a temperature of 320 deg. for 6 years and are still good. Monel metal is reported by one to have had a life of 2 years while another reports an indefinite life. Spellarized steel tubes are said to have lasted 1½ years. One mill has found that ordinary steel lasted 12 months when temperatures and density were high and 2 to 3 years under other conditions. A mill finds that plain steel tubes have a life of 6 years. Swedish charcoal steel tubes have had a life of 5 years in high density effect and much longer in other effects. Other materials that are recommended are: 12 per cent and 17 per cent chromium steels. Another mill reports using steel and

Diffuser bottoms of Monel, wrought iron, stainless or low carbon steel show most resistance to pitting

suggests vapor side with nickel coating. The life of the first effect has been 8 years and of the other effects 5 to 6 years.

Stainless steel, steel with high finish, Swedish charcoal steel and Monel tubes were said to scale least. Scaling can be retarded by keeping the tubes clean or by using stock and rosin-free liquors, low Na_2SO_4 content or by selecting proper refractories.

Where the black liquor is handled with pumps, the most satisfactory metals to use for pistons and piston rods are Monel metal, stainless steel, cast iron and Ni-Resist. Also, 3 per cent nickel-iron has been suggested for pistons.

In the washing of kraft pulp on vacuum filters nearly every mill finds Monel metal is best suited for the wire cloth, although four mills preferred stainless steel, and one nickel.

Materials considered best suited for pumps handling condensate from multi-effect evaporators are: 18-8 stainless steel, Monel, Elcomet K, dense semi-steel cast iron, and acid resisting bronze. Three mills use cast iron and plain steel and have no problem. Another reports condensate taken out with Monel water eductor. While a third reports condensate pumps for evaporators are being replaced with all Monel or 18-8 bodies, impellers and shafts.

The next question concerned materials found to be best suited for conveying vapors given off from contaminated condensate leaving evaporator or from other vapors exuding from concentrated liquor tanks, diffusers, smelting furnaces, etc. For piping plain steel, stainless steel and cast iron were reported. For ducts, plain steel, stainless steel cast iron, galvanized iron, Transite brick and asphalt covering were preferred. For fans, plain steel, cast iron, black iron, galvanized iron, Monel and stainless steel were favored. A chlorinated rubber paint on steel was also recommended. In one case

wrought iron for all parts has been used with fair results.

Cast iron, stainless steel and high silicon iron were reported to be best materials for pumps handling chlorine liquor. Cast iron has been in use 10 years in one mill. For bleach liquors, rubber lining or stainless steel were said to be best, but for chlorine water Hasteloy C was preferred.

For milk of lime pumps nine mills are using cast iron and two are employing 18-8 stainless steel. Others advise using chilled iron, 5 per cent nickel casings, Ni-Resist, semi-steel. Another recommends buying the cheapest cast iron available and replacing it whenever necessary.

There was a unanimous opinion that open impellers are best for pumping liquids as in recausticizing service containing abrasives in suspension (such as lime sludge) purely from the standpont of impeller life rather than pumping efficiency.

Cast iron is most generally used for impeller construction, but 18-8 stainless steel KA_3Mo, plain steel, manganese steel, low nickel iron castings, 3 per cent Ni-iron cast steel and Cataract metal are also employed. Monel metal for shafts is another favorite; while still another recommendation is that Monel construction with shafts of 18-8 Mo or 5 per cent chromium steel be used.

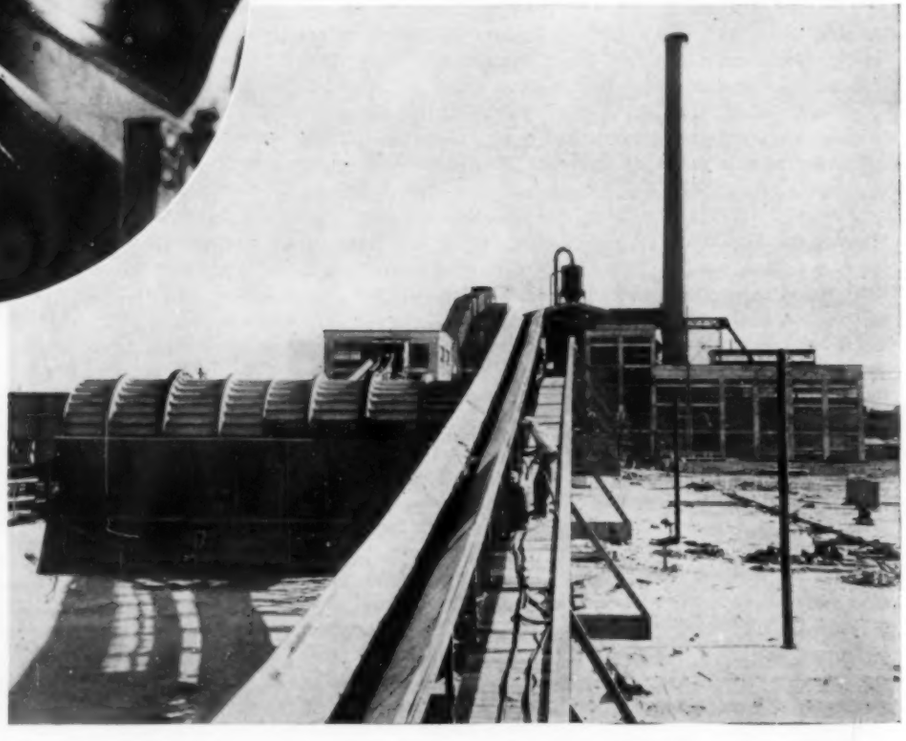
Steel appears to be almost universally used for lime slaking tanks or tank linings. Several use concrete lined steel tanks. Other materials in use are cast iron, black iron, tile and red brick.

Seven mills state that corrosion difficulties have been experienced in white liquor clarifying tanks at the liquor levels in continuous causticizing systems. Materials recommended for construction of such tanks are: steel, brick lining, stainless steel lining at liquor level, or all stainless steel throughout if expense warrants it. The consensus of opinion seems to be to use heaviest gage steel plate available, all welded construction.

Eleven report soapstone has been found to be best for refractory linings of smelter furnaces. Seven prefer chrome refractories, another uses fire brick, while still another employs chrome ore. One mill uses 9 in. chrome brick wall in bottom well insulated, and soapstone or very dense fire brick upper section. Chrome brick in smelting zone and No. 1 fire brick for combustion chamber and rotary have also been recommended. Another suggests using Wagner ore brick or Tomlinson plastic chrome in smelting zone.

Water jacketed furnace bodies have proved satisfactory in many mills. Only one mill has found them unsatisfactory.

The materials that have been found to be best suited for handling salt cake are: plain steel and cast iron. Iron screw or belt conveyor are recommended. Ordinary conveying equipment has been satisfactory in one case. Plain steel and wood were recommended for handling salt cake dust. It was suggested that by dampening the salt cake dust it could be easily handled.



Rubber belt conveyors are used to carry the chips to the storage bins above the digesters. Right—Continuous rotary barkers remove the bark from the logs while they are on their way from storage to the pulp mill. Here the problem of abrasion is more severe than corrosion

Coatings offer protection against the corrosives referred to above. Chlorinated rubber paint and S.D.O. are useful in bleach plant against vapors, acid waters, and chlorine, while sprayed metal coatings are particularly useful on pump impellers.

The opinion is expressed that erosion plays a part, as well as corrosion. Crystalline salts in suspension in black liquor plays an important part in excessive maintenance of pipe lines and pumps. It should be eliminated through change in operation. It is believed that much wear blamed on corrosion is really due to erosion.

Summary of Another Survey

When presenting the summary of his survey, Faunce stated that there were four definite purposes in the investigation:

1. To determine what corrosive and abrasive conditions are encountered by pulp and paper producers.
2. To find what specific problems in this connection are faced by individual mills.
3. To find out what is being done in specific instances to overcome such problems.
4. To try to determine what can be done to make available to all mills and equipment builders, reliable information on the most effective solutions to general problems.

In this survey the superintendents, technical directors, engineers, chemists and purchasing agents were contacted. Because some of the information is confidential, and as it is rather broad in form, it will be impossible to list comprehensively the entire mass for reference purposes in a discussion of this kind. However, in a general way a few of the outstanding things that were found in contacting the sulphate mills will be mentioned so as to give a semblance of a picture of the industry from a metal angle.

It was found that some of the plants were experiencing rather bad pitting in the plate of the digesters, particularly around the welds. An 18-8 stainless liner has already been tried as a means of combating the combined corrosive and abrasive action encountered in the bottom of the digesters. The lining is placed in the lower part of the cone and extends to the steam inlet. It is fabricated from $\frac{1}{8}$ in. plate and is proving most satisfactory.

The steam and liquor inlets and outlets on the digesters are usually made of ordinary steel in which case a large amount of cutting is encountered. No wide usage of alloy materials was uncovered, but in a few cases they are being tried and are proving successful.

The perforated screens used in diffuser bottoms are made of ordinary steel in many cases, but the tendency of the mills seems to be toward corrosion and abrasion resistant metals. One would expect that a stainless steel would prove most satisfactory for this application.

Black liquor evaporators seem to be a source of worry as severe pitting is encountered at the top and sides of the units. Some mills have replaced evaporator shells several times. It was also found in these units that tubes and tube sheets were subject to fairly rapid deterioration. This condition has been overcome by the use of an 18-8 stainless steel flashing and lining and by the use of stainless steel tubes and tube sheets.

In one particular mill it was stated that although the solution handled in the black liquor evaporator is basic the vapor is decidedly acid, which undoubtedly accounts for the severe corrosion encountered near the top of the unit. From all indications 18-8 stainless steel is most successful but there is a possibility that some other grades might adequately cope with the situation, and might even more economically overcome the conditions encountered.

The pulp mill of the Kraft Corp. of America, a subsidiary of the Container Corp. of America, at Fernandina, Fla. All illustrations in article were supplied through the courtesy of this organization

A few of those mills contacted are encountering considerable difficulty with their causticizing equipment. Some do not complain of the causticizing tank itself, but complain of the rapid failure of tubes leading from the tank to other pieces of equipment. This is probably a combined corrosion and abrasion problem. A few mills are having trouble with their settling equipment and it is believed that this is the same general condition that is encountered in the causticizers.

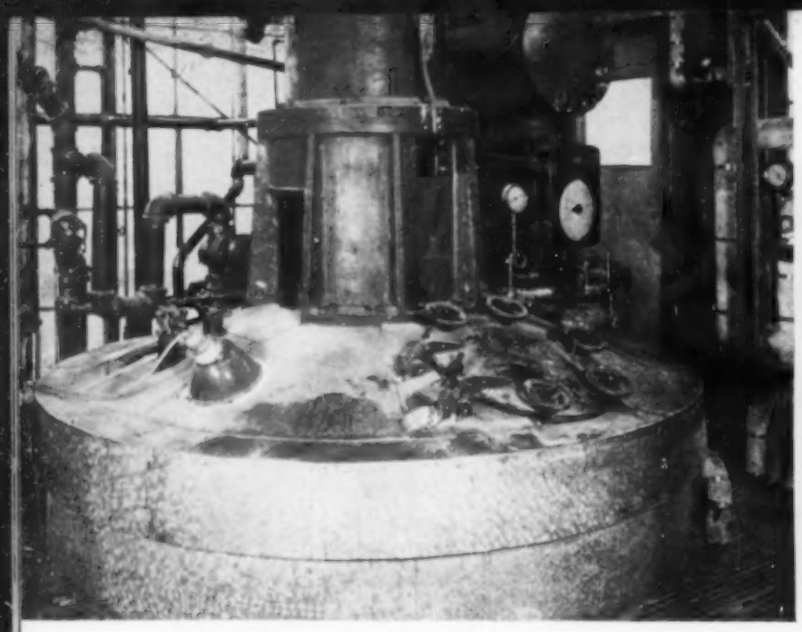
It has been found that the 18-8 type of stainless steel is best suited for condenser and evaporator tubes.

Various materials of construction are being tried for wash pans, metal tubes in direct heaters, pumps of all kinds, vacuum filters, multiple effect evaporators, filter spouts, and the handling of salt cake and salt cake dust.

With reference to stainless steel usage in paper mills, it was found that these metals seem to be giving good service for many pieces of equipment such as head boxes, flow boxes, regulating tanks, drainage pans, jordan bars, doctor blades, rolls, distributing tanks and suction boxes. The 18-8 grades are apparently the most widely used stainless steels in this department of the industry. It is believed that it would be worth while to determine whether in all cases it is the most economical grade.

Little is known in the mills about the many existing types of stainless steels. In practically all cases where stainless steel is used it is either an 18-8 or an 18-8 SMo, which is a modification of the standard analysis with molybdenum added. It might be advisable to call attention to the fact that there are other types of stainless steels the alloy content of which ranges from 12 or 13 per cent chromium to as much as 25 per cent chromium and 12 per cent nickel.

In general it can be said of stainless steels that their resistance to corrosion is almost a direct but far from linear function of the alloy content of the metals in question. There is a wide range of alloy steels from which to choose, as well as many other basic types of metals that might be considered comparable to these.



One of five cast iron reaction kettles ranging in size from 300 to 1,600 gal. Kettles are rotated by explosion proof motors

The General Electric Co.'s Pittsfield, Mass., plastics molding plant is said to be the largest in the world

Phenolic Resins

By JAMES A. LEE
MANAGING EDITOR
CHEMICAL & METALLURGICAL ENGINEERING

NO. 1 PLASTICS AVENUE, Pittsfield, Mass., is rapidly becoming one of the best known addresses in the plastics industry. And is it any wonder for here is located the largest molding plant in the world? A few months ago the General Electric Co. was forced to transfer its plastics molding operations to this new location where the facilities could be greatly enlarged.

Many varieties of plastics are molded into hundreds of different articles ranging in size all the way from tiny electrical parts, to housings for machines of considerable size. Urea and cellulose molding powders are purchased, but the phenolic resins which are the most important from a volume standpoint are produced here at the Pittsfield Works of the company. This resin plant also supplies four other G.E. molding plants.

The phenolic molding powders and varnish compounds are processed in a multi-story building. It was designed specifically for the purpose of making these products. The raw materials are brought in on a siding which goes the full length of the building and beyond to a series of storage houses and storage tanks. The principal raw materials are phenol and cresol to the amount of several million pounds a year, wood flour to the extent of about 100 car loads per year, sufficient formaldehyde to react with the phenol, alcohol, and other organic solvents for the phenolic varnishes, and many other resins, although none the less important, materials such as various acid and alkaline catalysts, dyes, pigments, waxes, asbestos, cotton flock, macerated cotton fabric, diatomaceous earth, mica dust, etc. The formaldehyde is stored out of door in large aluminum tanks. The phenol, cresols, cresylic acid, etc., are stored in underground heated steel tanks.

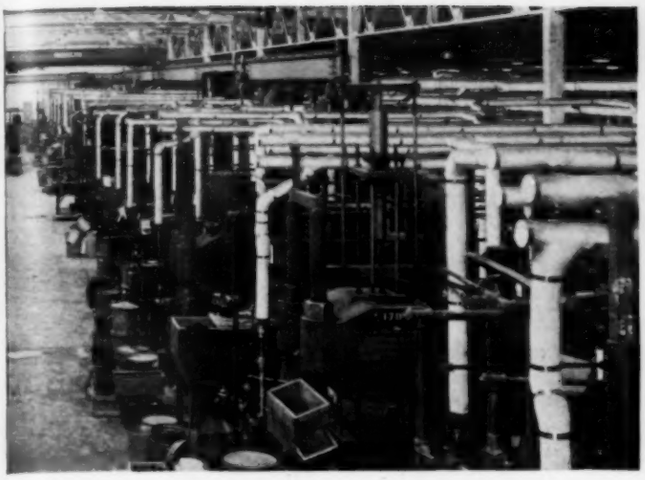
These raw materials are pumped by remote control into aluminum weigh tanks at the top of the building. From here the materials flow by gravity into one of the five cast iron reaction kettles, ranging in size from 300 gal. to 1,600 gal. The kettles are equipped with stirrers which also serve to scrape the resin off of the interior surfaces. They are rotated by explosion proof motors. Before the vapors from the kettles are permitted to escape into the atmosphere, they are passed through a washer which removes objectionable odors.

Some of the kettles are used only for alkaline catalyzed reactions of phenol and formaldehyde, others are employed for acid catalyzed reactions. When the reaction is completed the resin is either cut with alcohol or other organic solvent to make a varnish for producing laminated products, or is drawn off as a resin. That material intended for varnishes is drawn off from the kettles into blending tanks. One tank is reserved for black varnish and the other for clear varnish. From these tanks it goes into drums for shipment to the Lynn, Mass., plant of the company where all laminated phenolic plastics are manufactured. Several million pounds of varnishes are produced per year.

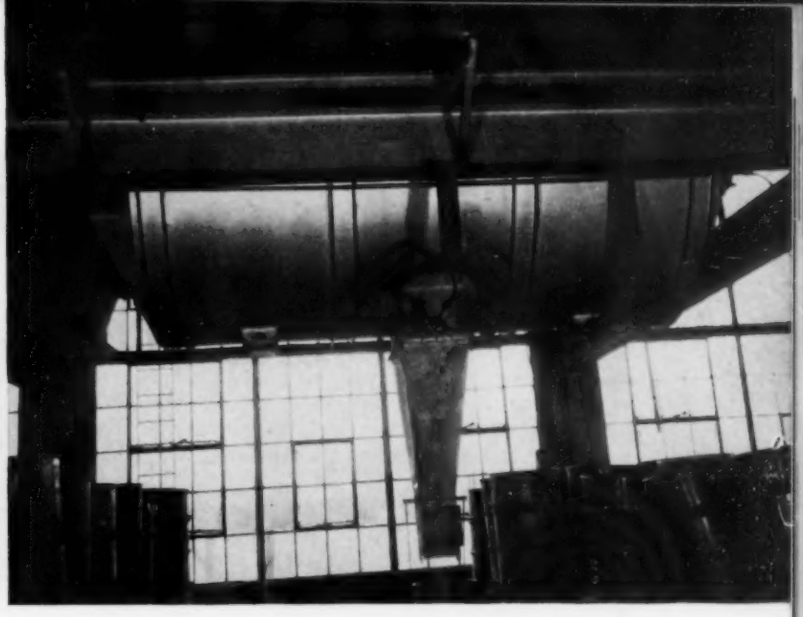
The batches of resin prepared for use as molding powders flow through an open metal trough to the floor below. The bottom of the trough is cooled by a stream of water. The resin is spread over the floor in a layer 2 to 3 in. in thickness.

The solid resin is broken with a sledge hammer, put into drums and elevated to an upper floor. Here the

G. E. was forced to transfer its molding operations to this new location where facilities could be greatly enlarged



All press molds in this plant are heated with water at 370 deg. F., pumped directly from steam-boiler drums



After leaving banbury mixers compounded material is cooled, crushed, pulverized and blended in large lots to secure uniformity

Produced at Pittsfield

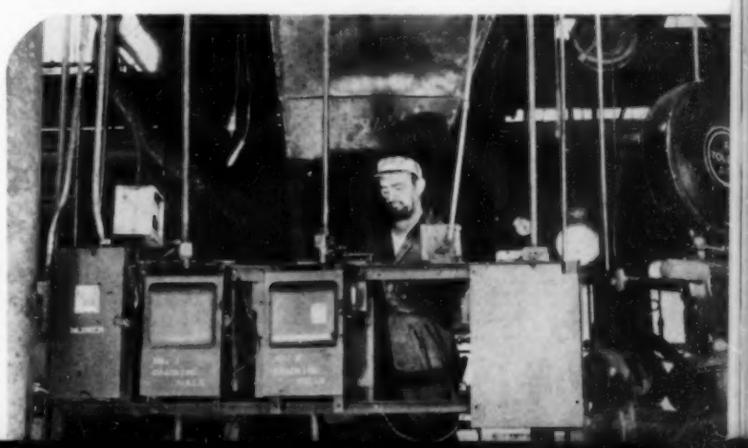
resin, hexamethylenetetramine and other ingredients are weighed, passed through a saw-tooth crusher, then through a hammer mill, and finally through a vibrating, fine mesh silk screen. The mixture goes through a ribbon blender and is ready to go into the compound manufacturing department.

In the compounding end of the building the materials are all dry and consist of the resin, wood flour, other fillers, dyes, pigments, lubricants, etc. Here the raw materials start at the top and come down. They are weighed-in in proper proportions and sent through any one of the six blenders or ball mill mixers. Here the mixture is weighed out and masticated in either one of the banbury mixers or on the rolls. The banburys are used for making the standard runs of black and brown compounds. The rolls are usually used only on special batches or very short runs. After leaving the banbury the material is cooled, crushed, pulverized and blended in large lots in order to secure uniformity. From here it goes into shipping drums for shipment into the warehouse which is in a nearby building or to the molding plant which is about a mile and a half away. This compound plant has a capacity in the neighborhood of 10,000,000 lb. per year.

All of the above sounds very simple but the manufacture of phenolic resins, varnishes and compounds is one which runs smoothly only so long as there is a very careful and precise control of both the raw materials and the processes. To effect this control a considerable laboratory staff is required in the compound plant. It is divided into two groups. The first group is in an analytical laboratory and makes all tests on incoming raw materials to make sure that they meet specifications. This group also makes control tests on the resins during the course of the reaction to determine the end point, and also on the finished resins and varnishes to make sure that they have the characteristics desired. The other group looks after the control of molding compound and tests each batch to determine its flow and cure characteristics, examines it for appearance, tests it for its electrical properties and for its static and impact strength. On looking over the flow sheet of the compound, resin and varnish plant, 57 control points have been counted. This very close control over compounds and varnishes makes the job much easier in the molding and laminating plants.

In all, there are about 18 different types of molding compounds, depending upon the type of resin and filler used. Each type of compound has its own unique set of physical and electrical properties. This plant also manufactures about six different types of phenolic varnishes for laminated plastics. The formulation of all of these resins, varnishes and compounds is prescribed by the development laboratory, which has a personnel of about 12 men, all chemists and chemical engineers under the direction of R. V. Boyer. Here is done all the development work on the uses of new raw materials, the writing of specifications and methods of test, the development of new formulations with improved characteristics and the writing of the manufacturing specifications for these, the development of new methods of compound manufacture and the supervision of the control laboratories. Production of the resins is also under the supervision of Boyer.

Here the mixture is weighed out and masticated in either one of the several banbury mixers or on the rolls



Pointers on Selecting Equipment for Industrial Gas Cleaning

By C. E. MILLER
CONSULTING CHEMICAL ENGINEER
ASHVILLE, N. C.

IT IS OFTEN necessary, or desirable, to remove suspended material from the gases resulting from various industrial operations. The suspended material may be valuable, or an undesired impurity in the gas which would interfere with subsequent operations, or it may constitute a nuisance or a menace to health and property which must be removed before the gas is discharged into the atmosphere.

A wide variety of equipment is available for this operation, the most common types being settling chambers; cyclones and other inertial apparatus; gas washers, both of the non-mechanical and mechanical types; gas filters; and electrical precipitators. Laboratory investigations of the dust-free zone surrounding hot bodies, and of the effect of sonic and supersonic vibrations in causing aggregation of smoke particles, have not yet resulted in industrial application.[1,2,3,4]

In general, the field of usefulness of the different types of gas cleaning equipment depends chiefly on the particle size of the material suspended in the gas. Each type is subject to certain limitations as to operating temperature, humidity of the gas, dust loading and the physical and chemical characteristics of the suspended matter. Ability to withstand corrosive conditions is frequently a governing factor, and in almost all cases, the relative cost of different types of equipment has an important influence on the type selected. In the selection of proper equipment, all these factors must be considered and the most reliable basis for choice is actual trial of the equipment under operating conditions. However, consideration of previous work in this field, laboratory investigations and the laws governing the design of gas cleaning equipment will generally be helpful in limiting the amount of testing necessary to arrive at a proper choice.

With the partial exception of filtration, gas cleaning methods involve the application of forces which will result in the relative movement of the suspended matter through the gas to collecting surfaces. These forces may be gravity, centrifugal or electrical forces, the molecular forces causing diffusion of the particle or the inertia of the particle as compared with the inertia of the gas molecules. Even in filtration methods, a simple sieving action will not completely account for the results, as the openings in the filter medium may be many times larger than the particles being removed, so contact and adhesion to surfaces undoubtedly has an effect in this case also.[15,5]

The size of the particle largely governs its velocity of movement through a gas, and for this reason, the effectiveness of the separating method. Various methods of determining particle size have been reported in the literature[5], but these methods are, in general, too elaborate and sensitive for field use. By means of a simple apparatus which has been used by the writer for the purpose, at least a qualitative idea of particle size and uniformity can be obtained.* The method has the advantages of cheapness, simplicity and adaptability to field use.

Aerosol is a term commonly applied to the more or less stable dispersions of solid or liquid particles in a gas. Aerosols are formed in two general ways—by mechanical dispersion, as in grinding solids or spraying liquids, or by condensation methods, as when a fog or mist is formed by the rapid cooling of a saturated gas. The properties of these disperse systems depend largely on the size of the particles and differ from those of the dispersoid-free gas about as those of a liquid sol differ from the pure solvent. Gibbs has summarized these properties and classifies aerosols as "dusts," "clouds," and "smokes" on the basis of particle size.[6,7]

Properties of Aerosols

A tabulation of some properties of typical aerosols, taken from various sources[5,7,13,14,15] is given in Fig. 1, which follows similar tabulations by Frank[8] and Moxley[9]. In general, mechanical dispersoids are coarser than condensed dispersoids, and in grinding and other mechanical operations, the quantity of material below 0.5 to 1 micron is usually a very small percentage of the total weight[10]. Blomfield found that in the average industrial dust only about 21 per cent of the total number of particles was smaller than 1 micron, whereas in the normal outdoor air, most of the particles were below this limit[11]. Condensed dispersoids such as smokes, fumes and mists, being formed from particles originally of molecular dimensions, have much lower size limits. The lower limit must approach that of the component molecules, but because of

* The equipment consists of a Cenco-Ryerson Brownian Movements apparatus (Central Scientific Co., Chicago, Article No. 71,270, price $3), designed for mounting on the stage of a compound microscope. The microscope is turned until the stage is in a vertical position, the smoke chamber is illuminated from above with almost any source of light, fair results being obtained with an ordinary flashlight, the dust particles in the illuminated field are viewed at a magnification of about 100 diameters, and their rate of settling across the field under the influence of gravity may be estimated. An approximate idea of the size distribution may also be obtained by observation of the uniformity of movement of the particles across the field. Because of the immense number of particles usually present, better results are obtained if the gas is diluted with air, and this procedure also tends to minimize disturbances due to temperature differences, convection currents, etc. While the method is not quantitative, it does give some indication of particle size, and experience with this procedure on different aerosols may enable an observer to predict the probable action of a given type of apparatus on a new gas, from its known behavior on a familiar gas.

the rapid mobility and frequent collisions of these very small particles, rapid aggregation takes place during the early stages of the formation of a smoke[7,12]. Measurements during the more stable period following this initial period of rapid flocculation give values such as those reported in Fig. 1.

Near the top of the chart the laws expressing the terminal velocity of a particle moving through a gas under the influence of gravity are shown, together with the approximate limits of the different regions, and the constants for differently shaped bodies falling through air at room temperature and pressure. The marked effect of particle size, especially below 100 microns, is evident from an inspection of the equations, or calculation of settling velocity over a range of particle sizes. As an example an irregularly shaped particle of 2.5 sp. gr. settling in air at room temperature and atmospheric pressure should reach the following terminal velocities, depending on its size:

Diameter, Microns	Terminal Velocity, Feet per Min.
5,000	3,140
500	470
50	24
5	0.24
0.5	0.0032
0.05	0.00011

If the dispersoid particles are large enough, the simplest method of effecting separation is by the use of a settling chamber, the dimensions of which may be calculated from the velocity formulas if the particle size is known. The use of trays or shelves to give short settling distances, and wire, chains, etc., suspended in the gas stream to prevent eddy currents, gives improved results, but, in general, settling chambers are limited to aerosols containing particles larger than 50 or 100 microns, or to applications where a separation of certain larger sizes is desirable.

In cyclones and similar centrifugal apparatus, the centrifugal forme mV^2/r acting on a particle of mass m, moving with a velocity V in a circular path of radius r, is combined with Stokes Law to furnish the mathematical basis for cyclone design[13,14]. By making V sufficiently large and r small, separating forces many times that of gravity may be developed in commercially practical apparatus, and consequently the terminal velocity of the particle may be made many times that given above.

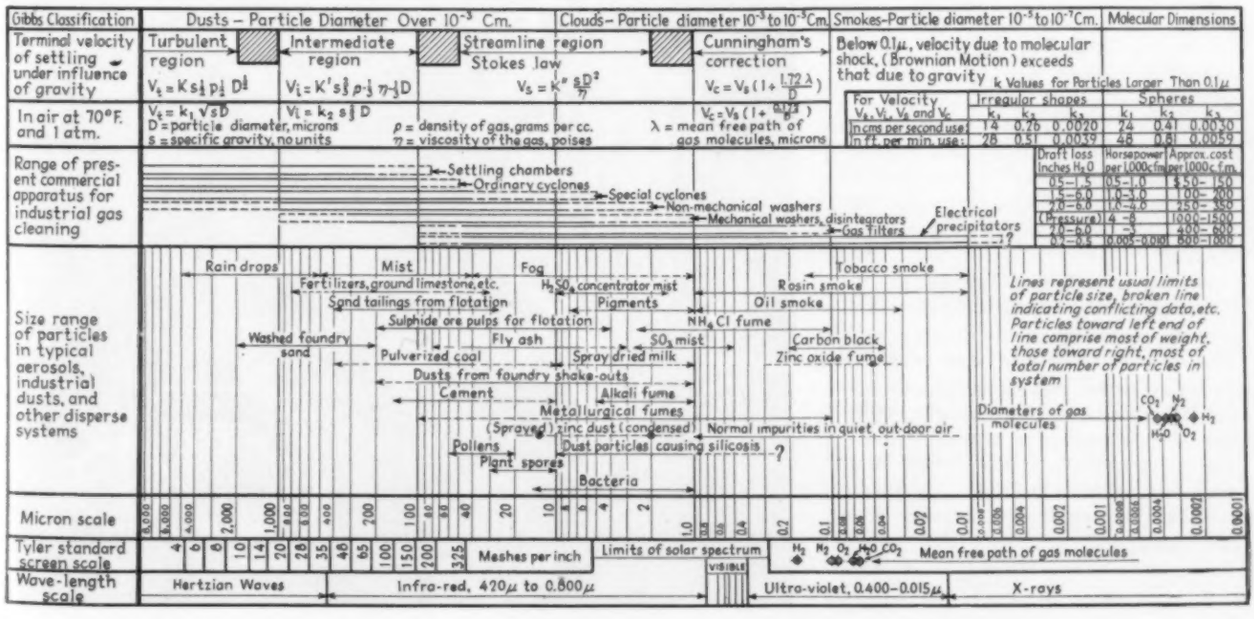
The chief difficulties in cyclone design are to provide a sufficiently long length of path, or a sufficiently short separating distance to permit the particle to move to a collecting surface during the short period of time in which it is subjected to the separating force; to prevent the subsequent re-mixing of dust and gas and to do these things without an excessive pressure drop through the apparatus.

Centrifugal Collecting Apparatus

Various devices are used to accomplish these ends. In Fig. 2, a short separating distance and long path are obtained by connecting a group of long, small diameter cyclones in parallel. Fig. 3 shows a compound type, consisting of a primary unit, the concentrator, and a secondary unit, the cyclone. Dust in the gases entering the primary unit is concentrated by centrifugal force toward the primary casing. The outer layer of gas bearing the heavily concentrated dust is passed to the secondary unit (the cyclone) where the actual separation takes place. That portion of the gas entering the primary unit which is not passed to the cyclone, together with the cleaned gas leaving the cyclone, is discharged through a central opening in the bottom of the primary unit. The design is claimed to recognize and minimize the generally detrimental effects of the secondary gas movements always present in rotating masses of gas, i.e., the so-called double eddy currents. In Fig. 4 the gas passage through the cyclone forming the third stage of the gas washer is divided into thin parallel strips by means of rubber vanes, and consequently dust particles and water droplets need to travel only a comparatively short distance to reach a collecting surface.

Moxley[9] gives results of tests on a number of types of

Fig. 1—Summary of properties of some typical aerosols


Gibbs Classification
Dusts – Particle Diameter Over 10⁻³ Cm.
Clouds – Particle diameter 10⁻³ to 10⁻⁵ Cm.
Smokes – Particle diameter 10⁻⁵ to 10⁻⁷ Cm.
Molecular Dimensions
Terminal velocity of settling under influence of gravity
Turbulent region
Intermediate region
Streamline region
Stokes law
Cunningham's correction
Below 0.1μ, velocity due to molecular shock, (Brownian Motion) exceeds that due to gravity
In air at 70°F. and 1 atm.
D = particle diameter, microns
s = specific gravity, no units
ρ = density of gas, grams per cc.
η = viscosity of the gas, poises
λ = mean free path of gas molecules, microns
Range of present commercial apparatus for industrial gas cleaning
Settling chambers
Ordinary cyclones
Special cyclones
Non-mechanical washers
Mechanical washers, disintegrators
Gas filters
Electrical precipitators
Size range of particles in typical aerosols, industrial dusts, and other disperse systems
Rain drops
Mist
Fog
Tobacco smoke
Fertilizers, ground limestone, etc.
Rosin smoke
Sand tailings from flotation
Pigments
Oil smoke
Sulphide ore pulps for flotation
Washed foundry sand
Fly ash
Carbon black
Pulverized coal
Spray dried milk
Zinc oxide fume
Dusts from foundry shake-outs
Cement
Alkali fume
Metallurgical fumes
(Sprayed) zinc dust (condensed)
Normal impurities in quiet out-door air
Pollens
Dust particles causing silicosis
Plant spores
Bacteria
Lines represent usual limits of particle size, broken line indicating conflicting data, etc. Particles toward left end of line comprise most of weight, those toward right, most of total number of particles in system
Diameters of gas molecules
Micron scale
Tyler standard screen scale
Meshes per inch
Limits of solar spectrum
VISIBLE
Mean free path of gas molecules
Wave-length scale
Hertzian Waves
Infra-red, 420μ to 0.800μ
Ultra-violet, 0.400–0.015μ
X-rays

gas cleaning equipment operated on air containing foundry dust. Under these conditions, ordinary cyclones were effective on particles above 70-75 microns and the more advanced designs lowered this limit to 35-40 microns. The type shown in Fig. 3 is claimed to collect 90 per cent or more of all particles above 20 microns, and 80 per cent or more of the 10 micron particles when operating on stack gases containing fly ash[17]. With other designs, in which very high velocities and pressure drops are used, satisfactory collection of particles as small as 5 microns is claimed[18].

Whiton gives results of tests on cyclones of various diameters and lengths, operating on electrically precipitated fly ash added to air heated to various temperatures[18]. Collection efficiency, as well as draft loss and costs, increase with decreased diameter or increased velocity. Dust loadings between 5 and 20 grains per cu. ft. had little effect on efficiency. Between room temperature and 500 deg. F. a temperature increase of 100 deg. F. caused a decrease in collection efficiency of about 2 per cent on a weight basis.

Cyclones are comparatively inexpensive both in first cost and operating cost, can operate at any dust loading and at any temperature up to the working limit of the structural material. They must usually be operated above the dew point of the gas, if the dust is to be discharged freely, although wet cyclones are not subject to this limitation.

Related to cyclones in performance are the fan type gas cleaners, in which the high rotational velocity of a gas passing through the fan is utilized to effect a separation of solids. Moxley[9] reports results of tests on this type of apparatus which indicate a performance similar to that of the more efficient cyclones. This type is also comparatively inexpensive and has about the same limitations as to temperature, humidity and other factors as the cyclones.

Recent developments in gas washing equipment have resulted in a very marked extension of the field of application of this type of apparatus. Spray towers and other types of washing equipment, in which the gas was passed at low velocity, countercurrent to the washing fluid through empty, packed or baffled towers, were not usually very effective, especially on gas containing finely divided solids, and the poor results obtained in this type of equipment were generally explained by assuming the existence of a gas film around the particle which prevented wetting.

Recent laboratory investigations indicate that the effects of a gas film around suspended particles may have been over-emphasized. For example: Whytlaw-Gray[19] states that "although the suspended particles in a gas doubtless absorb molecules of the medium, the effect appears to have little influence on their adhesion. . . . Smoke particles, of whatever substance they are composed, stick together when Brownian motion brings them in contact. Probably a high percentage of the collisions is effective, and although this has not been proved by direct experiment, it has been shown that adherence results from the majority of collisions between smoke particles of different kinds with various surfaces." Stumpf and Jander[20] state that "the majority of collisions between particles lead to aggregation. . . ." and "so far, attempts to stabilize aerosols, either by electrification subsequent to preparation, or by addition of other substances, have met with no real success."

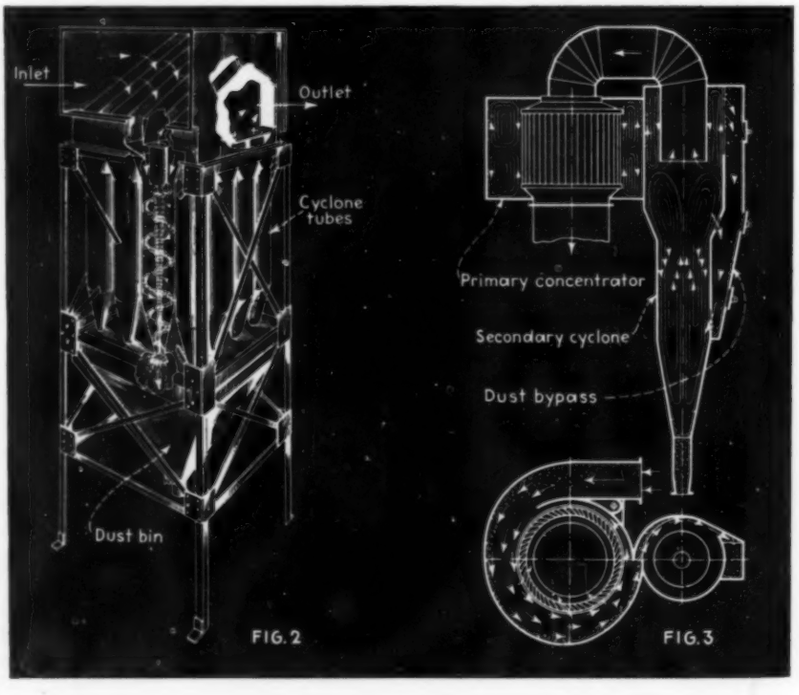
No general mathematical basis for the design of gas washers has been advanced, and recent developments are largely the result of the manufacturers' experience and tests. In general, the action consists in a large number of contacts between the gas, moving at fairly high velocity, and wet surfaces. A small percentage of the total dust removed by impingement at each contact amounts to a high percentage of recovery if the number of contacts is sufficiently large.

Performance of Washers

The equipment may be classified as non-mechanical washers, in which there are no mechanically operated parts and of which Figs. 4 and 5 show recent examples, and mechanical washers such as disintegrators. The non-mechanical type has the advantage of simplicity, low power consumption, moderate cost and effectiveness considerably beyond the range of cyclonic apparatus. Recent tests by members of the engineering staff of a prominent university on a widely used type of washer operating on foundry dust indicated recovery of over 99 per cent of particles from 2 microns down to the limit of visibility in light field counting. Water is the usual washing fluid, but one type of washer also adds a small quantity of oil to promote wetting of dispersoids

Fig. 2—Multiclone dust collector (Western Precipitation Co.)

Fig. 3—Compound type dust collector (Van Tongeren System, Buell Engineering Co.)



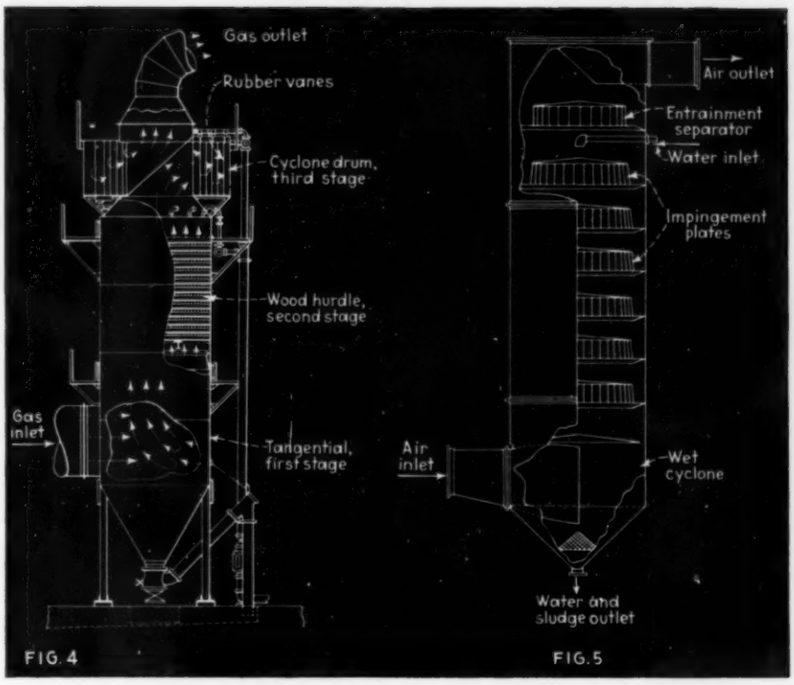


Fig. 4—Three-stage static gas washer (Freyn Engineering Co.)

Fig. 5—Multiwash dust collector (Claude B. Schneible Co.)

resistant to water. The quantity of water required is from 1 to 5 gal. per 1,000 cu. ft. of gas at room temperature, and correspondingly higher amounts for hot gases. Dust loadings below 50 grains per cu. ft. are generally preferred, there is no limitation to the moisture content of the gas and the equipment may be operated at temperatures approaching the boiling point of the washing fluid, which means very little limitation on gas temperature.

Mechanical washers, especially of the disintegrator type, depend on high speeds and fairly close clearances to accomplish the very violent mixing of the gas and scrubbing fluid which takes place during passage through the machine. Because of these facts, the first coat, power and operating costs are high and the field of application is restricted. High dust loadings and abrasive or corrosive materials in the gas are undesirable, but the lower limit of particle size is probably less than that reached in the non-mechanical washers.

Filters and Precipitators

The present limits of gas cleaning are reached by the use of gas filters and electrical precipitators. No radical changes in the design of these types have appeared recently. In gas filters, variations in the method of supporting the fabric and type of cleaning mechanism have their respective advantages and limitations. Gas velocities from 2 to 4 cu. ft. per min. per sq. ft. of filter surface are generally recommended, which results in a comparatively large and expensive installation to handle the volumes of gases usually encountered. The gas temperature must be above the dew point, and below about 180 deg. F. for cotton cloth or 200 to 225 deg. F. for wool. The use of glass fabrics is being actively investigated by the industry, with some promise of extending this range materially. Filtration is effective down to particle sizes of a few tenths of a micron with most solid dispersoids, but high dust loadings and abrasive materials are undesirable and tend to shorten fabric life.

With electrical precipitators, a high initial cost is largely offset by low power and operating costs. There seems to be no lower limit to the size of particles removed and very few limitations, other than economic ones. imposed by the humidity, temperature, dust loading of the gas, or percentage recovery. Recent work in this field includes the use of arc instead of mechanical rectifiers, pre-ionization of the gas and the development of compact, small-scale, self-contained units. For electrical cleaning of industrial gases, the familiar Cottrell apparatus seems to be still the standard.

In Fig. 1, the characteristics and limitations of the different types of gas cleaning equipment are summarized from data reported in the literature, manufacturers' catalogs, and other sources. These figures are believed to be representative of best present practice, but rapid development is taking place in this field and the range, efficiency and operating economy of different types of equipment are being extended. There is reason to suppose that present standards will be exceeded in the future.

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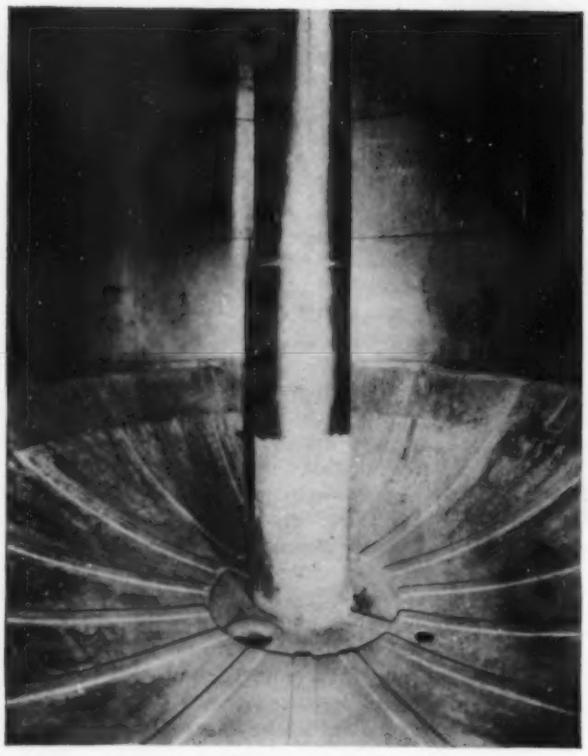
Is Increased Thickness of Steel



Interior of one of the new fermenters

By D. GUTLEBEN

PENNSYLVANIA SUGAR CO.
PHILADELPHIA, PA.

This is a practical approach to the design of equipment subject to corrosion. Use has been made of 13 years experience with similar equipment which was maintained with sprayed metal, special paints and other protective measures.—Editor.

IN 1924, the Pennsylvania Sugar Co. decided to install several fermenters in its alcohol distillery. At that time, there was little experience on which to base the specifications. During the 13 years that this equipment has been in use much data on the rate of corrosion, as well as on the costs and increased life by metal spraying, painting and other methods of maintenance have been accumulated. This information is now being used in designing the fermenters that are replacing the original installations.

When the seven fermenters went into service in November, 1924, they contained 48,750 lb. of ingot iron plates each. Thirteen years later the first one was removed for replacement and the junk man made return for 40,550 lb. The 8,200 lb. of waste of the iron during the 13 years represents an average of $\frac{1}{16}$ in. over the inside area of 3,150 sq.ft. The original tanks were riveted and the $\frac{3}{8}$ in. bottom plates were designed with the conventional factor of safety. Corrosion was not uniform but was most pronounced in the part of the side and bottom that was in the path of the falling mash and sulphuric acid that was charged through the roof. There still remained $\frac{1}{4}$ in. of good plate but the fermenting liquor was voraciously gnawing at the factor of safety and this was an uncomfortable thing to contemplate in view of the fact that each tank has a maximum capacity of 600 tons and is suspended in a compact space above an installation of CO_2 purifying equipment and a considerable number of workmen. To avoid the possibility of having all of the tanks condemned at the same time, two new ones were installed this year. The balance are expected to be replaced in the next two or three years.

When the original tanks were built, the specifications called for rivets and plates of ingot iron, but the rivets were not available in ingot iron, therefore requiring the substitution of another wrought iron. The inside heads of these wasted away in from 2 to 4 years and some became so loose that they fell out. The rivets were then replaced with the same material as the plates. These rivets in one fermenter lasted 10 years with slight repair by welding. The others required welding after 8 years. The lap-riveted joints were welded on both sides to bolster up the joint efficiency which was losing on account of corrosion. When the rivet heads began to look like coarse hog bristles they were chipped or burned off and replaced by welding with No. 5 Fleetweld covered rods. It was noted that where the plates were damaged by an awkward hammer blow or gouge of a chisel, a cancer started.

Stiffeners under the roof plates and struts and braces inside of the tank were attacked from both sides and therefore decreased in thickness at twice the rate of the shell plates. Two 6x6x$\frac{3}{8}$ in. ingot iron struts that were installed at two right angle diameters half way up from the bottom had fallen down a year ago and what was left was less than $\frac{1}{16}$ in. thick.

The maintenance of the old tanks included metal spraying, riveting, painting and welding. About two years after the tanks went into service some pitting was noticed. The possibilities of welding were not anticipated at that time and to avoid deterioration of the 30 in. pipes through which the house columns pass at the center of the tanks these were sand blasted and sprayed with tin. The tin remained intact several years. The No. 6 tank was sprayed with tin over its entire inside surface at a cost of about $4,000. This tank did not require re-riveting and no welding for 10 years while the others were re-riveted after 2 or 3 years and welded after 10 years. However, the cost of the tin spray raised the total maintenance of No. 6 by 30 per cent above the rest. There was no tin left on the plates 10 years later but the joints had to be chipped before welding because of the tin spray that filled the corners. Each tank received two paintings

the Answer?

of 2 or 3 coats of rubber paint and No. 4 received an additional painting with Sub-ox. Each painting lasted only a few months and its cost of $300 with cleaning and scaffolding was equal to nearly $\frac{1}{16}$ in. of iron. The painting is estimated to have extended the life of the tanks

Details of Welding Procedure

VERTICAL V-JOINTS in $\frac{5}{16}$ in. and $\frac{1}{2}$ in. shell joints.
1st; Apex bead; $\frac{1}{8}$ in. No. 5 wire; peened.
2nd; Bead; $\frac{5}{16}$ in. No. 5 wire; motor brushed.
3rd; Bead; $\frac{5}{16}$ in. No. 5 wire.
4th; Apex gouged and seal-welded; $\frac{1}{8}$ in. No. 5 wire; joint then ground to clear butt-strap.

BOTTOM V-JOINTS
1st; Apex bead; $\frac{1}{8}$ in. No. 5 wire; peened.
2nd; Bead; $\frac{5}{16}$ in. No. 5 wire; motor brushed.
3rd; Bead; $\frac{1}{4}$ in. No. 5 wire; chipped and ground to clear butt-strap.
4th; Apex gouged and seal-welded (overhead) $\frac{3}{32}$ in. No. 7 wire.

BUTT STRAPS
Two beads of $\frac{5}{16}$ in. No. 5 wire respectively peened and brushed, and one bead of $\frac{1}{4}$ in. No. 5 wire.

LAP JOINTS (Horizontal)
Inside—4 beads of $\frac{5}{16}$ in. No. 5 wire.
Outside—3 beads of $\frac{5}{16}$ in. No. 5 wire.
First bead peened; intermediate beads motor brushed.
The plates are lapped so that the overhead welding is outside.

ROOF ($\frac{5}{16}$ in. plate)
Top V-joint; $\frac{5}{16}$ in. No. 5 wire; peened and followed by $\frac{3}{32}$ in. No. 7 wire.
Bottom gouged and seal-welded (overhead) with $\frac{3}{32}$ in. No. 7 wire.

Note: No. 5 wire is easier to brush; No. 7 wire has to be chipped to remove the hard scale. There is less spatter with No. 7; it solidifies more quickly and makes a smoother job.

Data on the Old and New Fermenters

1924. Original riveted fermenters erected in the shipways of the New York Ship Building Company: delivered by barge and set into building site by two 100-ton cranes.

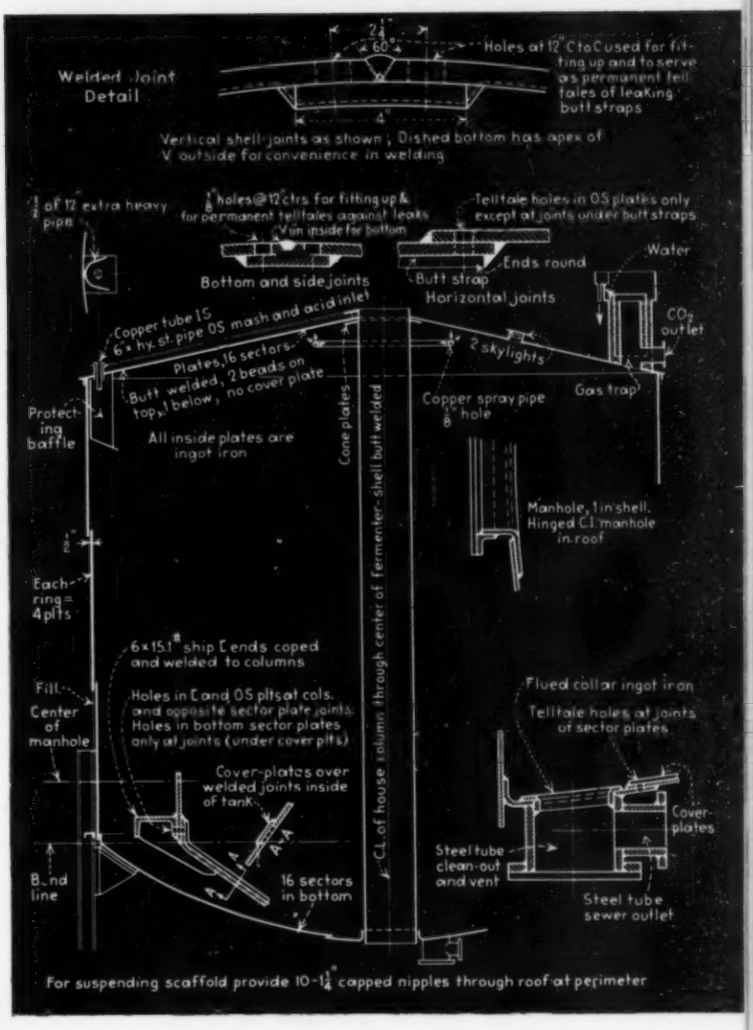
Tank	48,750 lb.	$4,900
Columns and manholes	10,550 lb.	767
Total (erected)	59,300 lb. at $189 per ton —	$5,667

1937. Welded fermenters No. 1 and 2 fitted in shops of Downington Iron Works: welded in field.
Tank (old columns and one manhole re-used) 73,670 lb. at $255 per ton — $9,125.58.

	Old Tank	*New Tank*
Joints — lineal feet (roof omitted)	850	670
Wt. of laps ($\frac{1}{4}$ in. and $\frac{5}{16}$ in. plates) and rivet heads (3,130+2,010)	5,140	.....
Wt. of butt straps, ($\frac{1}{2}$ in. and $\frac{5}{16}$ in. thick laps and welding rods, 4,000+2,050)	.....	6,250
Wt. of ingot iron plates	48,750	70,500
If flange steel had been used, cost would have decreased		250
If copper-bearing steel had been used, cost would have decreased		150
Cost of extra $\frac{1}{16}$ in. thickness		915

Cost — Fermenter No. 1

Contract — Downington Iron Works — fabricated material delivered. 73,670		$4,295.00	
Labor — Foreman, directing erection, 66 hr., welders and chippers, 964 hr. (Contract)		2,290.00	$6,585.00
Scaffold material: ventilating pipe: gas and air for cutting down		$162.79	
Gas trap, flanges, glass, misc. pipe		249.88	
Welding rods, 2,050 lb.		184.50	
Paint: Goodrich's Acid Seal, 43 gal.		196.93	$794.10
Labor: Removing old tank	534 hr.	$380.12	
Erection: Foreman	223 hr.	278.12	
Building scaffold	168 hr.	126.48	
Erecting and fitting	1,493 hr.	999.70	
Painting inside and removing scaffold	140 hr.	93.00	
Machine shop on traps and necks	75 hr.	50.83	$1,928.25
			$9,307.35
Credit for scrap sold: 2 tanks, 85,330 lb., $363.44: ½ to No. 1			181.72
TOTAL COST			$9,125.63


Welded Joint Detail
24"
60°
4"
Holes at 12" C to C used for fitting up and to serve as permanent tell tales of leaking butt straps
Vertical shell joints as shown; Dished bottom has apex of V outside for convenience in welding
2" of 12" extra heavy pipe
holes@12 ctrs for fitting up & for permanent telltales against leaks
V in inside for bottom
Telltale holes in OS plates only except at joints under butt straps
Water
Ends round
Bottom and side joints
Butt strap
Horizontal joints
CO2 outlet
Copper tube 15
6" hy. st. pipe OS mash and acid inlet
Plates, 16 sectors
Butt welded, 2 beads on top, 1 below, no cover plate
2 skylights
Gas trap
Copper spray pipe
8" hole
Protecting baffle
All inside plates are ingot iron
Cone plates
CL of house columns through center of fermenter-shell butt welded
Manhole, 1 in shell. Hinged CI manhole in roof
2"
Each ring = 4 pits
6×15.1# ship C ends coped and welded to columns
Holes in C and OS pits at cols. and opposite sector plate joints. Holes in bottom sector plates only at joints (under cover pits)
Fill
Center of manhole
Flued collar ingot iron
Telltale holes at joints of sector plates
Cover-plates over welded joints inside of tank
A-A
Cover-plates
Steel tube clean-out and vent
Bend line
16 sectors in bottom
Steel tube sewer outlet
For suspending scaffold provide 10-1¼" capped nipples through roof at perimeter

Plans for recently installed equipment in Pennsylvania Sugar Co. distillery

a year while the equivalent expenditure in additional iron would have added 10 years. The outside of the lap joints for four of the tanks was welded after 5 years of use and both inside and outside were welded within 12 years.

Expenditures for maintenance during the life of these tanks were as follows:

	No. 1		*No. 2*	
Tin spraying	Jan. 1927	$474	Jan. 1927	$521
Riveting	Aug. 1926	1,826	Mar. 1928	1,734
Welding	Feb. 1930	417	Apr. 1936	1,275
Painting	Feb. 1932	240	Oct. 1933	230
Painting	Oct. 1933	230	Apr. 1936	230
Total		$3,180		$3,990

Mash (Typical charge)

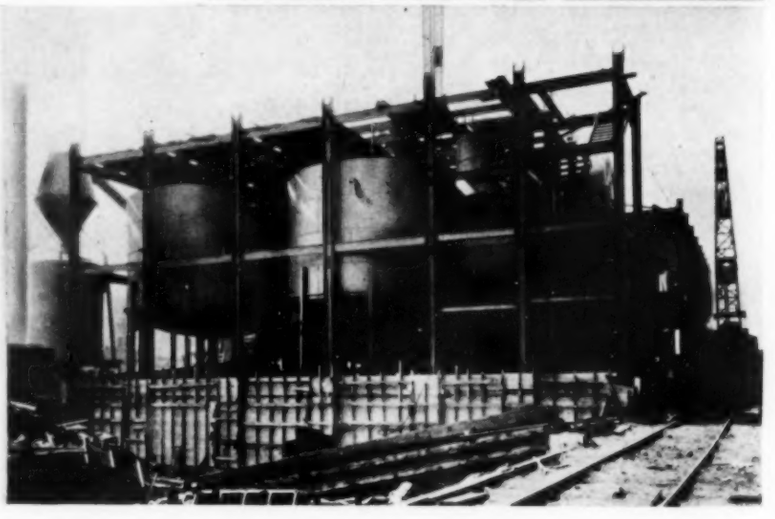
1 Operating volume in fermenter	84,000 gal.
2 Molasses	14,000 gal.
3 Sulphuric acid (66 Bé)	1,750 lb.
4 Yeast	8,000 gal.
5 Yeast food (ammonium sulphate)	200 lb.
50 lb. ammonium phosphate	

The molasses is diluted with water to 17—21 deg. Brix (the lower Brix applying in warmer weather). This mash is then charged into the fermenter until it is about half full. Then the yeast food is added, followed by the yeast. When the charge is about two-thirds complete, the acid is trickled in with the mash.

The new design omitted interior bracing and reduced the lineal feet of joints by 25 per cent by using the

largest plates that could be gotten into the building. Rivets, which were especially vulnerable in the old tanks, were avoided and the joints made by welding. And finally, structural strength and corrosion resistance received separate consideration. Structural stability required a thickness in the bottom of $\frac{3}{8}$ in. To this was added $\frac{3}{16}$ in. for corrosion, i.e. to capitalize maintenance cost. All circumferential (vertical) joints and those in the spherical bottom were butt welded. These joints resist internal pressure. They are covered with butt straps in order to avoid having them weakened by corrosion. When the butt-strap requires re-welding, it can be made narrower in order to weld it to the uncorroded shell plate. The girth joints are lapped and welded. The operators did not object to vertical butt straps since a vigorous spray is provided for cleaning.

The V-joints in all of the plates are welded in multiple beads, each bead being finished for the entire tank, then peened and brushed before the succeeding one is applied. The apex of the V is then gouged out and seal-welded with one bead. The inside joint is chipped and ground smooth in order to clear the butt strap. The butt strap welds are likewise made in multiple beads and successively peened and brushed. When the welding of the butt joints was finished and before they were covered with the butt straps, the erection holes were plugged with corks and the tank was tested with water. Thereafter the butt straps were welded on. The test load caused a deflection of $\frac{1}{8}$ in. of the dished bottom. The subsequent welding of the butt straps caused a permanent deflection of an additional $\frac{1}{2}$ in. The column brackets were welded on after the deflection. The welders insisted on a precise fit. The joints were brought together accurately at a high expense for labor. Fleetweld covered rods were used. In detail, the procedure was as shown on the previous page.



Installing the original fermenters in the alcohol distillery

Stream Pollution Becomes a Problem For Chemical Engineers

EDITORIAL STAFF INTERPRETATION

PREVENTION of stream pollution has become a chemical engineering problem quite as much as one of sanitary engineering importance. Process industry throughout the country is finding it necessary to make extensive investigations and frequently to install costly effluent disposal works in order to prevent the contamination of streams. The benefits to the general public in purer water supply are no less than the benefits to industry, many units of which require water free from contamination.

All of these problems have been spotlighted recently by the advancing of federal legislation almost to the

point of enactment by Congress. As first passed by the House of Representatives, the Vinson Bill provides that the Public Health Service shall make a nation-wide investigation of streams and set up a basis for cooperation with municipalities and with industry to minimize the pollution of waterways. A more drastic form of measure was passed by the Senate, which would require the setting of definite standards of quality for various streams, with rigid enforcement after a brief waiting period of a few years. This more rigorous plan would make the Public Health Service a policeman of waterways, not merely a guide and cooperating agency with means to give financial aid where required. Whichever form of legislation is finally enacted, the problem is unchanged technically. But new economic and political factors will be injected if the more vigorous system proposed by Senator Barkley in the Senate bill should prevail.

The chemical industry has been investigating these matters through the Manufacturing Chemists Association. Facts of nationwide significance have been developed and presented to Congress. These indicate clearly the scope of the problem and some of the major considerations which must be taken into account in its settlement.

Contamination of waterways is more frequently occasioned by municipal sewage discharge than by industrial wastes. It is estimated that the sewage from 40,000,000 people is discharged into streams without treatment. Few industries have been as negligent as our municipalities, few would be allowed to be under state or local laws.

Pre-Treatment Plant Investment

M.C.A., representing 87 corporations with 230 plants, has determined that only 31 of these find it necessary to treat the water which they use. Of this number, 18 find pre-treatment necessary because of the presence of sewage, only 13 because of the presence of trade wastes. For these pre-treatment plants manufacturing chemists have invested $2,500,000 in equipment and spend annually approximately $350,000 for operating expense. This same industrial group includes 18 establishments which have modified their manufacturing processes to avoid discharge of wastes with capital expenditure of $950,000 and additional operating expenses of $87,000 per year. Of the 230 plants in the industry, 47 have installed equipment for trade waste treatment at a capital cost of over $3,000,000, involving annual operating costs of $400,000 above the salvage value of extracted wastes.

This impressive story of attention to stream pollution prevention represents only the service of chemicals manufacturers. Many other divisions of process industry have been equally diligent, and some have spent even larger sums to prevent stream contamination. There is little to indicate that industry has been negligent, but much to show that municipal sewage discharge has not been adequately controlled. There is a mutuality of interest, because municipalities are dependent on industries for their financial and population well-being, quite as much as the industries are dependent upon the municipalities for service or employee resources. Process industry, therefore, has argued that the solution of industrial stream pollution problems is intimately interwoven with control of sewage contamination, and should be so considered.

Each locality has its own problems. In fact, technically speaking, each plant is a problem in itself, whether it be a works for sewage treatment or a works for petroleum refining. Sound engineering, guided by reasonable economic considerations, must govern, or efforts at prevention of pollution will break down under the burden of excessive costs. There is no justification for negligence. But there is equally no justification for arbitrary sweeping regulatory effort which can accomplish little or nothing. Such effort might, in fact, delay truly corrective measures by bringing discredit on even sound methods.

Time to Resurvey Effluent Problems

Each executive of process industry will probably soon find it part of his job to resurvey the effluent problems at every works over which he has charge. He will need to know the quantity and character of effluent, and the variation in both characteristics with variation in business activity or with changes in processes used. Then he must relate this information to the sewage or stream conditions. Particularly it will be important to determine how much more serious are the effluent discharges during periods of low water than during flood times. Unfortunately, it will probably be necessary to plan corrective projects on the basis of maximum permissible contamination at times of minimum stream flow.

In cases where the plant effluent goes into a municipal sewer system, there are important problems involved in the effect of the effluent on sewage disposal works. Obviously flammable vapors or highly corrosive chemicals cannot be discharged without unreasonable burden on sewage disposal facilities. In some cases certain of the effluent constituents may operate to prevent the proper functioning of otherwise good sewage disposal processes. Activated sludge processes, for example, are often interfered with by chemicals of strong bactericidal action.

The chemical process industries have been practically unanimous in their support of a sound program for national correction of contaminated water conditions. But the support has been almost unanimous also for cooperative federal guidance with state or local administration. The industries believe that Public Health Service can be entrusted with the research, general administration, and coordination of all of the multitude of projects which must be planned. But the majority feel strongly that the Public Health Service should not be made a policeman, with duties of detailed administration and the enforcement of rigid regulations. This latter job can be done better by state authorities or by regional cooperation through interstate compacts.

Problems Cannot Be Postponed

Altogether the industries' problems cannot be postponed. In many cases effluent treatment, adequate and economic in form, can be developed only after further experimental studies and engineering development work. These take time. It is important, therefore, that the problems of each plant be clearly defined soon, and that the investigations for their solution be authorized at as early a date as possible. As the industries set their own plants in order they can more forcefully insist that municipalities do likewise with respect to sewage discharge. The result will be more satisfactory cleaner water supply, a result of great dollar value to industry as well as to the general public.

Control panels in power house of the Charleston, S. C., kraft mill of the West Virginia Pulp & Paper Co., d.c. switchboard at the right and switch-room ventilating ducts at top

MODERN ELECTRICAL WIRING Is a Necessity

By W. F. DEMMERLE
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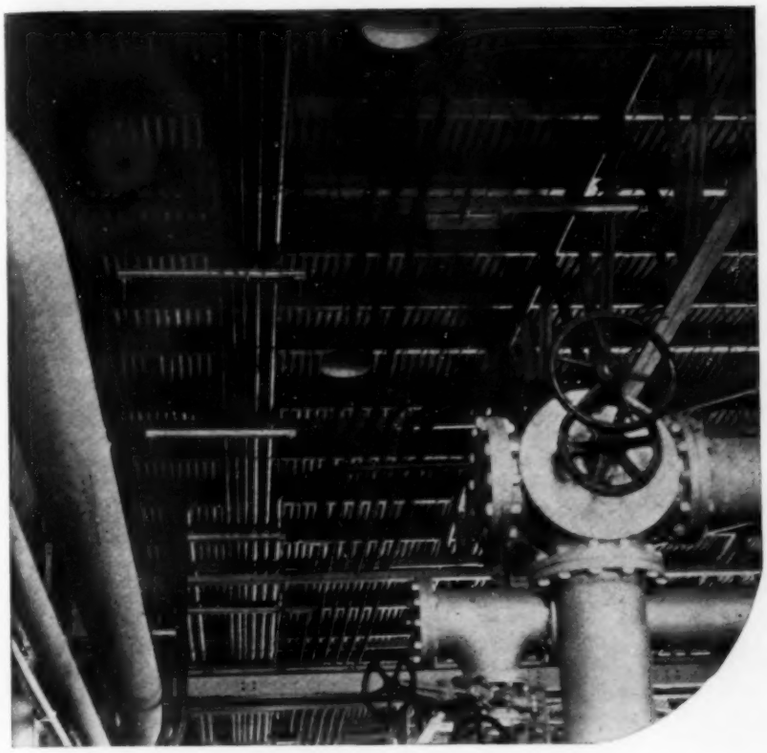
A NEW PLANT and modern equipment require adequate and modern electrical wiring in order to operate at maximum efficiency. This principle was recognized by the West Virginia Pulp & Paper Co. when the new kraft pulp mill was planned for Charleston, S. C. It was also realized that adequate and modern wiring was necessary to secure a reliable, safe installation of low maintenance costs. In deciding on the type of electrical equipment and the details of the installation the company's engineers drew on the long experience in the other five mills of the organization. Many of the older mills have been added to or modernized recently, so that in almost every case it was possible to check the desirability or performance of each phase of the design or proposed method of installation for the new mill. In addition, the electrical installations in some of the mills recently built by other organizations were scrutinized for ideas.

General Scheme

The general scheme that was decided on for the new mill is given here. Power is generated and distributed at 3 phase, 60 cycles, 2,300 volts. All motors of 50 hp. and larger operate at 2,300 volts. The smaller motors are all 440 volts, except some of fractional horsepower, principally in the water treatment plant, which are on the 110 volt lighting circuit. The total connected load is about 23,000 hp., 17 per cent of which is 440 volt motors of less than 50 hp. The generating capacity is now 15,000 kva., with an actual load of about 11,500 kw. Of the 19,000 connected horsepower of 2,300 volt motors, 11,000 hp. are synchronous. The largest single motor of this group is used to drive the paper machine through its sectional drive. The next largest group consists of 150 hp. and 350 hp. motors driving jordans. The others include chipper motors, vacuum pump and air compressor motors, etc. With the exception of the paper machine drive motor, which has its own exciter, all the synchronous motors are separately excited. This large synchronous load permits the operation of the generators at a very high power factor.

The power plant is capable of expansion to more than double its original size while still maintaining the general scheme of the design. The building, housing the two 7,500 kva. turbo-generators, is large enough for a third unit and is easily capable of extension to house several more machines. The electrical control panels and switch structure are housed in a separate portion of the building along the ends of the generators, so this part of the structure also can be extended easily.

The arrangement of this switch house may be of interest. The generator and feeder control panels are located on an extension of the main operating floor of the power house. The switch room located above the control panels is completely enclosed and is ventilated and cooled by washed air. In this room are located the buses, oil switches, the usual supporting racks, etc. Above the switch room is a cable loft, through which the feeder cables pass. This loft permits arranging the feeder switches in the order dictated by the bus design and yet allows the cables to leave the power plant in a logical order, by providing space for transposition where needed. The cable loft, together with the balcony which surrounds it on the outside of the building, will make repairs and additions extremely easy, as ample working space is pro-



Feeder cables under jordan room roof. Cables with flexible steel armor at right, cables in rigid conduit can be noticed at left

vided and no scaffolding whatsoever will be required.

The bus consists of rectangular copper arranged in a modified hollow square. The installation will handle the contemplated additions of load without reinforcing. Any additional units which may be added to the mill will require an extension of the bus, for which space has been provided. When this time arrives, additional generating capacity will be needed, which will be connected to the bus extension.

An Auxiliary Bus

In order to permit the use of breakers of reasonable dimensions and rupturing capacity with the large synchronous load to be carried, it will be necessary to connect the present bus with the future extension through a tie breaker. It will be the duty of this breaker to separate the system into two smaller units in event of serious short circuit. A short auxiliary bus has been installed, to which either of the present generators and certain essential loads may be connected. It is the intention that this auxiliary bus will eventually become a true house bus, when expansion of the plant permits using one generator largely for the essential load.

The generator leads are square copper tubes enclosed in Transite ducts, running from the switch room to just outside the enclosure for the generator cooling system. The switch room is maintained at a slight positive pressure; air leaks out through the generator lead enclosures, the feeder cable floor and wall bushings, thus cooling these conductors and keeping out possible accumulations of dust.

The present plant load calls for the continual operation of both generators leaving no standby generator capacity. This situation is aided by a tie to the South Carolina Power Co.'s system. Power may be fed to the utility's system, and, in an emergency, enough power can be drawn from it to permit the mill to operate almost at capacity with one generating unit shut down.

The system is operated with an ungrounded neutral. To get complete protection the differential relays of the generators are augmented by reverse power and overload relays. With this combination, together with the inverse time limit overload relays on the feeder breakers, it is felt that practically any fault in the system will be automatically cleared or generators shut down quickly enough to prevent serious damage—particularly to generators or bus. To aid in protecting the generators, the field switches are interlocked with the main generator breakers to remove excitation automatically when the machine is cut off the line. The line to the pumping station is considered one of the essential services. Since this is a pole line for a large part of its length, running through woodland in a bad lightning area, reclosing relays were included for its protection.

The power house control panels are steel with the usual complement of instruments for generators and feeders. Graphic instruments are included for the generators and for station voltage, frequency and total load. For convenience of operation, duplicate generator wattmeters and turbine governor control switches are mounted adjacent to the steam meters on the turbine control panels at the steam end of the generating units.

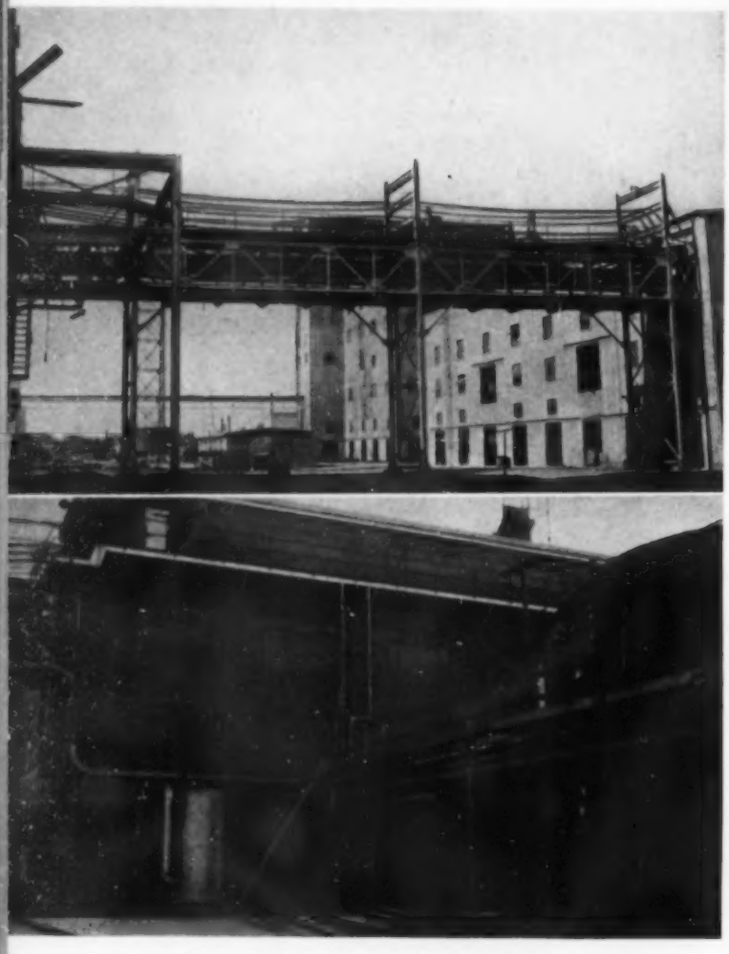
The oil switches are electrically operated from a 125 volt lead storage battery located in a room in the basement. The battery is continuously trickle-charged by a rectifier and can also be given a heavy charge from the d.c. system. The dim-bright system of switch control was adopted, which, with the relay operation indicators, greatly aids in keeping correct records of automatic breaker operation.

Generators have direct-connected exciters, for which one steam-driven standby has been provided. Excitation can also be obtained from the system supplying miscellaneous d.c. loads in the shops and paper mill. A small separate switchboard is provided to control this d.c. load.

Distribution of two voltages through the kraft mill with about 4,000 hp. connected load on the 440 volt system would have proved cumbersome, inefficient and expensive if the transformation to 440 volts were made at one or two points and 440 volt feeders run to all departments. A study of the situation resulted in the installation of banks of single phase Pyranol filled transformers in each building, drawing energy from the 2,300 volt

feeder supplying the larger motors in the department and feeding only the 440 volt motors in that department. These transformers, not requiring fireproof vaults, were located, without enclosures of any kind, in the most convenient locations, usually near the 2,300 volt switch gear.

It was necessary to add another voltage, 4,100, to the system to operate the pumping station some five miles



Top—Feeder cables on the pipe bridge between the power house and mill buildings. Bottom—Exterior of power plant showing cable loft and surrounding balcony

away. An economical line of this length with bus voltage at the generating end would have too large a drop for the proper operation of standard 2,300 volt motors at the pump house, particularly when starting a motor on an already partially loaded line. The voltage chosen permitted operating standard motors in the pump house at line voltage and required but one set of transformers located at the power plant.

A certain amount of direct current had to be distributed from the power house to shops and paper machine room, as well as to coal feeders for the main power boilers. The amount of d.c. power is small and its distribution presented no problems.

The 2,300 volt feeder cables through which all the power for the mill is fed are three-conductor, varnished cambric insulated, lead-covered cables. The relatively short length of these cables called for their calculation on a temperature basis rather than voltage drop. The operating temperatures were kept low and standard 5,000 volt conductor and belt insulation were employed, which should give a long normal life. Hard lead sheaths were specified as the cables were supported on messenger wire and cable rings for the outdoor portion of their runs. It was possible in most cases to support the feeders on pipe and conveyor bridges, thus keeping the yard free of additional supports. The cables are enclosed in steel, either rigid conduit or interlocking steel armor, in the indoor portions of their runs, to protect them from mechanical injury and to localize damage from possible electrical faults.

The 4,100 volt line to the pump house runs well out of the mill yard as a three-conductor varnished cambric and lead cable on a pipe bridge, where it joins the open line. Parkway cable is used for a portion of this line to simplify railroad and highway crossings. The open portion of the line is on wood piles through the company's right-of-way for the water main. This portion of the line is protected by an overhead welded copper ground wire, supplemented by lightning arresters and capacitors placed at the ends of the open runs.

Insulation

The power house ends of all the feeder cables terminate in potheads, from which bare copper bars run to the feeder breakers. The far ends of the feeders also terminate in pot heads fastened through the tops of the motor control cubicles. The 2,300 volt line to motors and transformers is 5,000 volt varnished cambric insulated wire and is run in conduit. Thus the entire system of 2,300 volt circuits is enclosed in metal from the power house to the motor terminals. The 440 volt circuits are all 30 per cent rubber and braid run in conduit. In the general wiring no sizes smaller than No. 12 were used, as it was felt that the smaller sizes lack proper mechanical strength.

Each of the 2,300 volt motors is controlled by a completely enclosed semi-dust-tight cubicle. These are arranged in groups with enclosed buses in the upper compartments running the entire length of the group. The cubicles are equipped with oil switches, which, in most cases, are electrically operated. The operating current is d.c. in all cases, mostly drawn from sources of d.c. excitation. In some isolated instances where d.c. was not readily available, copper oxide rectifiers were used. Some manually operated cubicles were needed, principally for controlling the 2,300/440 volt transformer banks and the motor generator sets for synchronous motor excitation.

With a few exceptions, notably the motor of the paper machine drive motor generator set, all the motors in the plant are started across the line. Many are low inrush normal torque motors the higher cost of which is offset by the cheaper starters required. With the exception of the manually-operated breakers in the cubicles mentioned above and a few manual starters on small motors, all motors are controlled by push button stations, usually located remote from the starters.

The synchronous motor starters are completely automatic and are provided with a resynchronizing feature which restarts the motor if it pulls out of step. All the

cubicles are fitted with an a.c. ammeter and ammeter switch. The synchronous motor starters have, in addition, a d.c. ammeter for the field and a receptacle for plugging in a portable power factor meter. All the motor starters are equipped with thermal overload and under voltage protective devices, which, in the synchronous motor starters, are augmented by devices for protecting squirrel-cage windings from excessive temperature.

The primaries of the 2,300/440 volt transformers are fed through cubicles with manually operated oil switches and are protected by thermal overload relays. These transformers are fitted with terminal boxes for high and low voltage leads, making them completely safe for use without enclosures.

The secondaries of the stepdown transformers are not protected except where there are long runs to more than one distribution center. In these cases a main distribution panel is used, housing a thermal overload de-ion type air breaker for each circuit. The branch distribution panels are all equipped with thermal overload de-ion type air breakers, with one breaker per motor, except for some of the smaller motors which were grouped together on one breaker. Ample space was left in these distribution cabinets for future circuits. In each department one or more three-pole, 440 volt, 60 ampere receptacle was provided for the use of portable welding machines or other temporary drives.

The 440 volt starters are grouped together in convenient locations. Oil immersed contactors are used to start all the larger motors; below 5 hp. general purpose magnetic switches are used. All the starters have self-contained non-fusible disconnecting switches. In dusty or moist locations weather-proof housings were used. The balance of the starters are in standard enclosures. The push button stations were also divided between standard and weatherproof, depending upon the location.

All the wiring was run in galvanized conduits. Very few of the power conduits were embedded in the concrete floors. Where it was necessary to run conduits in the basement floor slab to motors and cubicles, these conduits were brought up out of the floor at the nearest convenient column, and for the balance of the run, are overhead, where subsequent changes will be easy to make.

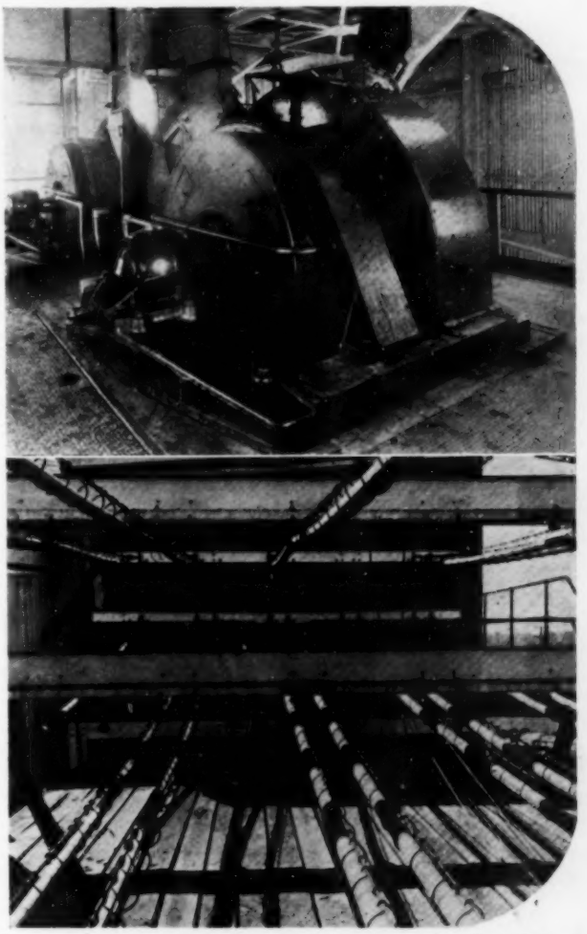
Wiring of Machine Drive

Wiring of the sectional drive for the paper machine presented some difficulty, principally in locating the multitude of large conduits required for the heavy cables to section motors. The conduits were hung along the ceiling of the shipping platform, located under the drive motors. This in an ideal arrangement but headroom requirements made it necessary to bank the control conduits close above the power conduits. A sufficient number of pull boxes were provided in these runs so that replacements and changes can be made easily. For this wiring 30 per cent rubber insulated and braided conductors were used.

The plant lighting system is supplied from a 2,300 volt, 3 phase circuit, originating in a separate breaker in the power plant and having branches leading to every building. Single phase Pyranol transformers, protected by fused cutouts, were located inside each building. The lighting system panels are wired directly to the transformer secondaries without overload protection. The individual circuits, however, are protected by single pole breakers in the ungrounded line.

The boiler house and power plant are each supplied with two transformers feeding entirely separate lighting systems in order to provide as dependable light as possible in these buildings.

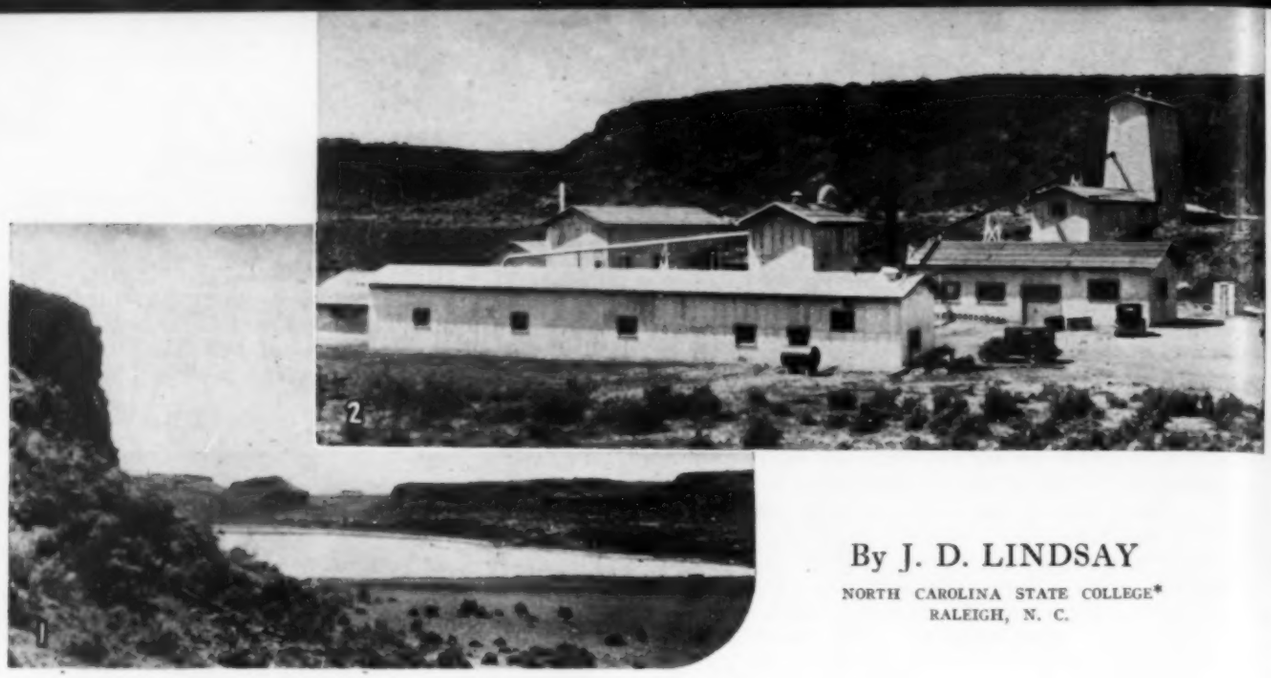
The general plant lighting is done by the conventional enameled steel reflector type unit with incandescent lamps. Vapor-proof type fixtures were used in the boiler house, digester building, recovery plant and other moist and dusty locations. The inside of the hood over the paper machine is wired with vapor-proof units producing very satisfactory illumination. The yard lighting is by projector-type units located in strategic positions.



Top—300 hp.- 277 r.p.m. synchronous chipper motors. These motors are cooled by clean outside air blown through the ducts shown. Air vane switches in the ducts will shut down the motor if the cooling air supply fails. Note the simplicity of the wiring. Bottom—Feeder cables leaving power house over pipe bridge

An automatic telephone system serving the offices and all departments of the mill was included in the layouts. The wiring for this system was also carefully arranged to keep the yard clear of overhead wires.

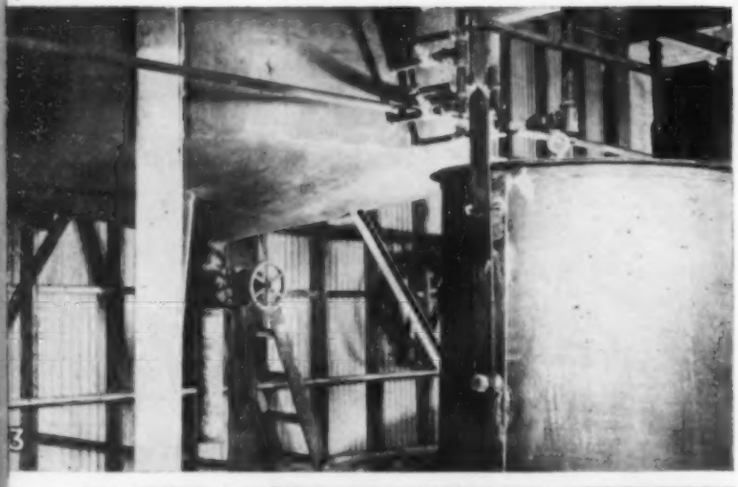
Design was handled by the engineering department of the paper company under the supervision of the author. Construction was carried out by the company's electrical organization, except the main control panel and switch structure work, which was handled by an outside firm.



By J. D. LINDSAY

NORTH CAROLINA STATE COLLEGE*
RALEIGH, N. C.

Producing NATURAL

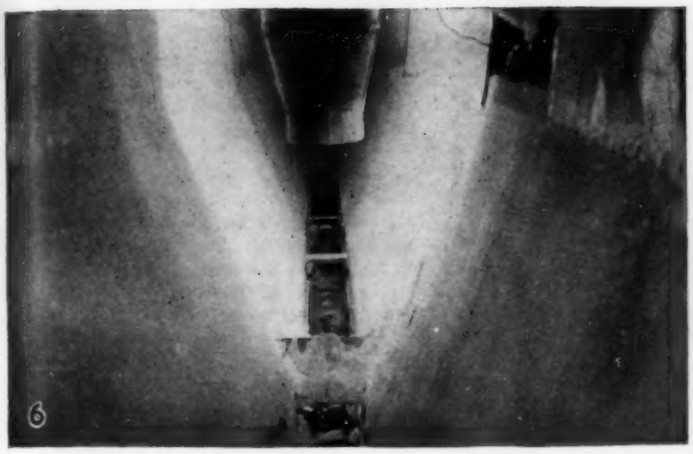


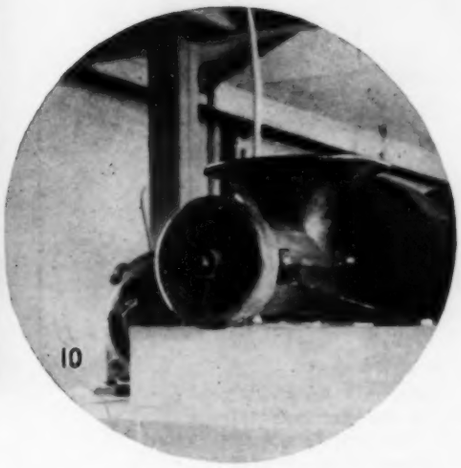
WITH THE ADVENT of large electric power facilities in the Pacific northwest, attention is being directed to this section of the country for plant location. The availability of certain basic chemical commodities within reasonable distances should also be considered. This article describes a plant which has been installed for the production of soda ash from a natural deposit in that region. The deposit and plant are located near the town of Wilson Creek which is about 100 miles west of Spokane, Wash. J. M. Gunning, 714 Paulsen Building, Spokane, and George F. Andersen, of Wilson Creek, head the organization which is known as the Sodium Products Co.

The lake, Fig. 1, lies between two rather high lava formations and occupies an area of approximately 13 acres. Drillings have been made to a depth of 50 ft. and still show good values. The deposit is rather pure sodium carbonate mixed with some insoluble silt. For a large part of the year the lake presents a white and crusty appearance with a damp, spongy structure below. Water for the process is obtained from two near-by springs. Approximately 1,000 ft. from the deposit the plant has been located. It consists of a group of corrugated iron buildings with concrete foundations, a general view of which is shown in Fig. 2.

The process dissolves the sodium carbonate from its bed, and after separating any insoluble matter, crystallizes, dries and granulates it to soda ash. Water is pumped into a pit in the deposit and heated to about 100 deg. F. by means of live steam. The boiler that furnishes this steam is fired by an oil burner. The warm water is allowed to leach out the sodium carbonate until a specific gravity of 32 deg. Bé. is reached, after which it is pumped to the settling tanks. There are three of these, each 8 ft. in diameter and 8 ft. deep. They are equipped with steam coils and drains at different levels.

*At the time this article was written the author was Professor of Chemical Engineering at the University of Idaho, Moscow, Idaho.



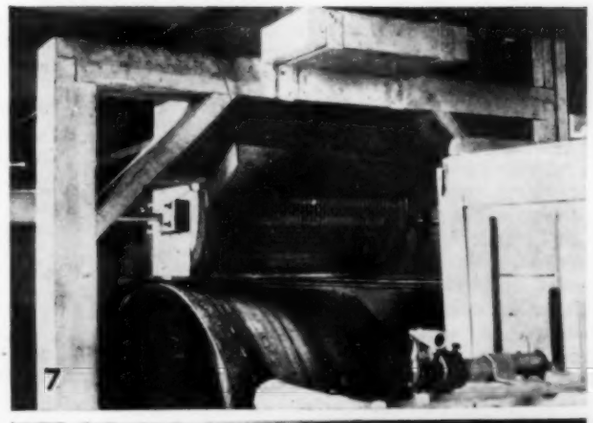


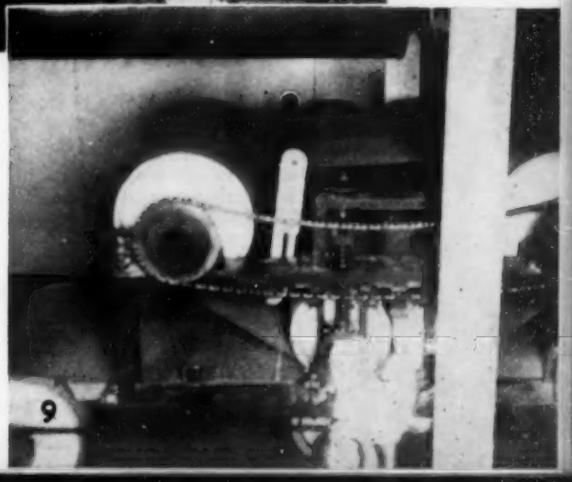
SODA ASH in Washington

A sand filter, Fig. 3, 3 ft. in diameter by 3 ft., hung on an overhead track, is used for further clarification of the liquor from the settling tanks. The solution is then allowed to flow to the crystallizing room.

Here, five tanks each 20x10x3 ft. are used as batch crystallizers. A general view of this room is shown in Fig. 4. After crystallization the mother liquor is drawn off and the crystals are shoveled out through a door in the end of the tank into a short chute. The chute introduces the crystals into the suction duct of a 26-in. fan. This system not only conveys the crystals but also acts as a disintegrator and accomplishes some drying. Separation of crystals from the air is effected by a cyclone which delivers them to a mill for further disintegration. The crystals are next given a preliminary air drying by blowing them through several hundred feet of 12-in. duct situated in a heated room (Fig. 5). The material is then conveyed by means of air to another building for final drying and granulating. In addition to a cyclone separator a large settling chamber is used to recover the fines. A screw conveyor at the bottom of this, as shown in Fig. 6, feeds a belt dryer.

Drying is carried out in two stages, the first of which employs a 24-in. steel belt running through a 30-ft. chamber. Below the belt are 18 compressed gas burners to furnish the required heat. A distributor, Fig. 7, consisting of rotating vanes within a screen, spreads the material on the belt. The time in the dryer (Fig. 8) is usually two minutes although this may be varied by means of a Sterling Speedtrol mechanism. As the material is discharged from the first stage of drying it can be squeezed into a plastic mass. This is accomplished by means of steel rolls covered with $\frac{3}{4}$-in. soft rubber. Belts feed through the rolls as illustrated in Fig. 9. An extrusion device (Fig. 10) produces granules of the desired size from the plastic material. After drying in equipment similar to that previously described, a hard, dense, free-flowing, granular product is obtained.





Readers' VIEWS and COMMENTS

Ceramic Engineering Education

To the Editor of Chem. & Met.:

Sir:—The editorial, "Example and Competition," in the January issue of *Chem. & Met.* interests me very much. Naturally, it is gratifying to note the recognition of the activities of the American Ceramic Society. Evidently, we have been too modest or perhaps other engineers have been incurious about ceramics. In all events, however, the problem of ceramic education has weighed heavily on the minds and consciences of our educators for many years and the matter has been the subject of very careful study. Through the activities of numerous committees, symposia, discussions in the Society Bulletin, etc., the opinions of many persons, representing the ideas of the employer as well as the educator, have been expressed.

Stating only my own opinion, I regard the recent survey by the E.C.P.D. as extremely useful in clarifying the problem. The members of the American Ceramic Society have not been unmindful of its importance, but the proposed organization of an Institute of Ceramic Engineers, mentioned in your editorial, is not the beginning but a continuation of the efforts of many.

C. W. PARMELEE
Head, Department of Ceramic Engineering
University of Illinois
Urbana, Illinois

To the Editor of Chem. & Met.:

Sir:—Your January editorial, "Example and Competition," has caught my eye, particularly with reference to the American Ceramic Society. In reading the editorial the uninformed might assume that the immediate activity referred to was the first in the interest of recognition of ceramic engineering education. It is this possible impression that I am taking the liberty of correcting.

For many years the American Ceramic Society has had a committee on education as one of its active standing committees, and much good work has been done in improving and standardizing curricula. More recently the Fellows of the Society, through a standing committee, have worked diligently and effectively along the same lines. Concurrently, there has been a movement on foot for several years looking to the formation of an Institute of Ceramic Engineers. In the immediate past, and to a large extent in cooperation with E.C.P.D., the entire field of ceramic engineering education has been restudied by a special committee. This group has been represented on various E.C.P.D. accrediting committees in their routine work, and as a result several of our educational institutions have been accredited in ceramic as well as other engineering departments.

Within the last several months the movement for the formation of an Institute of Ceramic Engineers has crystallized into a decision to form such an organization within the Society rather than as a separate unit.

In the above remarks, I am registering no criticism but am merely taking it upon myself in a personal way to call your attention to the facts as I see them. This letter should in no way be construed as representing an opinion from or of the Society.

EMERSON P. POSTE
Chemical Engineer
Chattanooga, Tenn.

ETHICS AND THE JOB

To the Editor of Chem. & Met.:

Sir:—I was particularly interested in what your January editorial had to say about the Association of Consulting Chemists and Chemical Engineers' report on competition.

Recently in reading over the new edition of the Constitution and Code of Ethics of the American Institute of Chemical Engineers, I was somewhat surprised to note that it is written as though all members of the Institute are engaged in consulting work. In fact, it is almost identical in meaning with the Code of Ethics of the Consulting Association. There is only one point in the Association code which has not been included also in the Institute code, and that is: a member shall refuse work for which he knows he is not qualified.

I have long felt that high professional status for the chemical engineer depends upon his willingness to regard his job as that of a consultant. However, the most difficult hurdle standing in the way of independent consultants is the tendency on the part of the engineer in regular employment to feel that it is a confession of weakness to ask his employer for outside help. In most cases this is not the engineer's fault but is due to a mistaken point of view on the part of the employer. As a rule, the better the company and the more competent its technical force, the more willing it is to use outsiders when their services are needed.

The situation is not one which can be changed overnight, but I do feel that a greater effort could be made to encourage acceptance of the attitude of the consultant by the profession in general.

JOHN P. HUBBELL
Singmaster & Breyer,
New York City.

WHY BOOKS COST MONEY

To the Editor of Chem. & Met.:

Sir:—I wish to reply to the interesting communication of L. Carlton Mertz on "More Books at Lower Prices" which appeared in your January issue.

Technical book publishing is not as profitable as most other businesses. As pointed out by Mr. Mertz, the total volume is relatively small. The dollar unit sale is low. Repeat orders for the same books from the same customer are non-existant. The publication of every new book is highly speculative. Regardless of their quality, many of the technical books published each year are financial failures. And in addition to these handicaps, book publishing is accompanied by high overhead and selling expense as well as a large capital investment.

Overhead and selling expense are kept high not by inefficiency on the part of the publisher, but rather by the expensive practices of a number of the chemists, engineers and other technical workers who buy books. For example, instead of carefully studying advertisements of books before ordering, some customers ask that they be sent on approval. The percentage of returned approval orders is astounding. Often returned books are soiled or improperly packed or marked, so that they are damaged, lost, or not credited properly. Also, collection expenses are high because professional men are not as dependable as they might be in keeping their accounts up to date.

If technical book buyers were to eliminate these evils which add to the publisher's expense, then the publisher would be in a position to sell at a lower price.

DOROTHY FRACHT
Chemical Publishing Co.
New York City.

Chemical Engineer's BOOKSHELF

New Chemical and Physical Data

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA, Index to Vol. VI-X (old series, 1923-1930) 360 pages. Price, $12. New Series Monographs: No. 1, "Deuterium" by H. C. Urey, 79 pages, $2; No. 2, "Dielectric Constants and Dipole Moments" by P. DeBye and H. Sack, 66 pages, $2; No. 3, "Free Energy, Heat Content, Entropy, Activity" by J. Gueron and J. P. Mathieu, 79 pages, $2; No. 4, "Heat Conductance and Specific Heat" by M. L. Brouty and F. Wolfers, 42 pages, $1; No. 5, "Elasticity, Compressibility, Expansion, Density, Viscosity, Surface Tension" by Sture Koch, T. W. J. Taylor, P. Auger and D. G. Dervichian, 72 pages, $1; No. 6, "Vapor Pressures, Boiling Temperatures and Gas Laws" by W. P. Jorissen, P. C. van Keekem, W. H. Keesom, J. J. M. van Santen and J. Haantjes, 65 pages, $1.50; No. 7, "Volta Effect, Thermoelectricity, Piezoelectricity, Metallic Electrical Conductivity, Supraconductivity" by F. Wolfers, R. Lucas and J. Mendousse, 30 pages, 16 Fr.; No. 8, "Paramagnetism, Diamagnetism, Ferromagnetism, Hall Effect" by G. Foex and L. Neel, 33 pages, 20 Fr.; No. 9, "Electromotive Forces, Oxidation-Reduction Potentials" by H. S. Harned and G. Akerlof, 45 pages, 25 Fr.; No. 10, "Thermochemistry" by W. A. Roth, 82 pages, 40 Fr.; No. 11, "Molecular Spectra and Molecular Structure—1st part: Diatomic Molecules" by V. Henri, 96 pages. Published by Hermann & Cie., Paris; McGraw-Hill Book Co., New York City.

Reviewed by *Hugh S. Taylor*

IT IS BECOMING increasingly realized that International Critical Tables do not constitute a permanent solution of the problem of physical and chemical data for chemists in pure and applied science. Data already ten years old have, in many cases, been rendered obsolete by newer experiment. Even the atomic weight table receives an annual revision.

For many years the Annual Tables of Constants and Numerical Data supplied the new material each year. Because of the War even these data fell behind. Now a vigorous effort by the International Commission, supported mainly by the French Government, has reduced the lag. The first part of Volume XI, just published in this country, covers much of the data of 1931-1934, and data from 1931-1936 are in preparation for the second part of Volume XI (Spring 1938) and for Volume XII. This has permitted a new experiment which is embodied in the series of monographs listed above. Each monograph contains the data of at least four years and in some cases six years, critically examined and compiled and made available to those who, not desiring to purchase the complete volumes, nevertheless have frequent need for particular sets of data. In these monographs, for an expenditure of one to two dollars, one can secure the authoritative new data in his own field.

Of the monographs listed above, Nos. 3, 4, 5, 6 and 10 should be especially useful to the industrial chemist or the chemical engineer. In No. 4, especially, he will find the data permitting determinations of equilibrium from free energy and entropy data. The petroleum industry will note upward of thirty common hydrocarbons for which ΔF, ΔH and ΔS are available. Corresponding data on heats of combustion are found in Monograph No. 10, by Roth. In the same monograph are thousands of newer data on heats of fusion, vaporization, dissociation, ionization, hydration, solution, etc. Vapor pressures and boiling points, and equations of state are in Monograph 6, solutions as well as pure substances being included. Of commercial interest we cite the vapor pressures of propane and propylene, solid and liquid carbon dioxide, with many binary and ternary systems in the later pages.

The reviewer believes that the appropriate monographs will eventually find their ways to the desks of industrial chemists and engineers, there to be retained and repeatedly used.

METALLOGRAPHY. Fourth edition. By *C. H. Desch.* Published by Longmans, Green & Co., London and New York. 402 pages. Price, $8.

MANY new topics are introduced in the new edition. Among the subjects treated are the improved technique in thermal analysis and in microscopical examination, studies of metallic structures, age-hardening and other changes in solid alloys, and the processes of mechanical deformation. All these subjects are treated in the light of modern physical and chemical knowledge.

POWDERED METAL ALLOYS

PRINCIPLES OF POWDER METALLURGY. By *W. D. Jones.* Published by Longmans, Green & Co., New York City; Edward Arnold & Co., London. 211 pages. Price, $5.

Reviewed by *R. E. Vivian*

THIS BOOK is the first treatise on powder metallurgy to appear in the English language. It is much more comprehensive than F. Skaupy's "Metallkeramik" (1930). The author devotes the first three chapters, or about half of his book, to the phenomenon of sintering and its underlying theory, including effects of particle size and shape, pressure, temperature, and other factors on the porosity and other properties of the sintered materials. He then goes on to describe the practical applications of sintering in the heat-treatment of pressed powdered metal articles, which he terms "compacts." The production of special and hard metal alloys and oil-less bearings is described.

The discussion of the manufacture, properties and testing of the metal powders themselves is well done, but it is too brief and is based largely on European practice. The statement is made that copper powder for oil-less bearings is manufactured chiefly by electrolytic methods. This is incorrect for the United States, where reduction of copper oxides is the chief method. The testing methods outlined could be improved by including other testing methods used in the United States, particularly in the oil-less bearing trade.

The book is well-written and has many excellent illustrations and photomicrographs. The profuse references to literature and patents are noteworthy. Many problems for future investigation are indicated. This book should be of interest to all metallurgists and very valuable to those in the field of powdered metals.

LIQUIDS AS FUELS

LIQUID FUELS. By *Harold Moore.* Published by D. Van Nostrand Co., Inc., New York City. 263 pages. Price, $8.

Reviewed by *R. T. Goodwin*

THE AUTHOR has endeavored to present in brief the main aspects of every type of liquid fuel in a manner intelligible and interesting to the technically minded who are not specialists in the field.

At first glance, the scope of the work appears to be unreasonably wide for a single volume and the subjects are, of necessity, covered rather sketchily. However, when the author's true purpose is thoroughly understood, the real value of the work is realized.

About a quarter of the volume is devoted to a description of the manufacture of the different liquid fuels, including those derived from petroleum, coal, lignite, wood, peat, animal and vegetable oils, as well as alcohol and synthetic fuels. In the second quarter the author covers the subject of engine fuels, their properties and applications to the different types of internal combustion engines. The third quarter is devoted to a discussion of liquid fuels for external application, i.e., liquefied gases, kerosene and fuel oils of various grades. In the remainder of the volume are presented the methods of analysis, tests and evaluation of liquid fuels. Throughout, the units of measurement, methods of test and types of equipment are British or Continental and are not entirely applicable to American practice.

There is much of general interest and educational value which should widen the reader's concept of the entire field of liquid fuels. However, the book should not be regarded as a comprehensive reference source on any one particular phase of this wide subject.

RECENT BOOKS AND PAMPHLETS

Check Sheet—Introduction of New Industrial Products, 1937 Revision, by O. C. Holleran, Market Research Series No. 6, U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce, 53 pages, Discusses steps in development and produc- 2 charts, 10 cents. Revision of original publication in 1935 covering problems involved in the marketing of a new product. tion of new products, details of marketing procedure, effects of various internal and external factors on industrial marketing. Charts revised to include several problems resulting from current business conditions and to eliminate some factors now outmoded.

A.S.T.M. Standards on Cement. Specifications for portland, high-early-strength portland, natural and masonry cements. Methods of testing cover portland cement, chemical analysis, compressive strength of mortars and fineness. Includes "Manual of Cement Testing" which emphasizes important factors in testing. 96 pages. Price $1; to A.S.T.M. members, $.75. —*on Refractory Materials.* Specifications and test methods for various types of fire-clay brick, ground fire clay and other refractories. Includes new section of design and operation of refractory-lined furnaces. Surveys have been made of conditions of refractories in the following industries: open-hearth steel, malleable iron, copper, lead. by-product coke and glass. 180 pages. Price, $1.25; to A.S.T.M. members, $1. - *on Rubber Products.* Revised edition including in latest approved form all of the 25 standards issued by the Society in this field. In addition to test procedures there are specifications covering fire hose, rubber pump valves, friction tape, rubber tape, various classes of insulated wire and cable, gloves for electrical workers, etc. 238 pages. Price, $1.25; to A.S.T.M. members, $1. All available from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, Pa.

Industrielle Elektrowärme. Part I (Development, Importance and Forms) RM 1; Part II (Fundamentals of Electric Heating Technique) 62 pages, RM 1; Part III (Where Electric Heating is Being Used Industrially) 116 pages, RM 1. *Elektrowärmetagung Berlin 1936* (descriptive catalogue of types of industries and equipment using electrical heating) 101 pages. RM 1.20. All in German. Publisher: Arbeitsgemeinschaft zur Förderung der Elektrowirtschaft, Berlin W35.

Coke From Illinois Coals, by Gilbert Thiessen. Bulletin No. 64, Illinois State Geological Survey, Urbana, Illinois. 235 pages. Discusses: outlook for a coke industry based upon Illinois coal, technology of coke manufacture, results of experimental investigations of coke production from Illinois coals.

Collected Papers From the Faculty of Science, Osaka Imperial University, Series C, Chemistry, Vol. IV. 1936. Osaka University, Osaka, Japan.

Ouro e Bauxita na Regiao do Gurupy, Bulletin 13; Geologia e Recursos Mineraes do Meio Norte, Bulletin 15; Contribuicao a Metallogenese do Massico Brasileiro, Bulletin 16; Geologia e Movimentos Sismicos de Bom Successo, Minas Geraes, Bulletin 17. Official publications. Departamento Nacional da Producao Mineral, Ministerio da Agricultura, Brazil.

Memoirs of the Faculty of Science and Engineering, Waseda University, Tokyo, Japan, No. 12, 1937. 189 pages. 59 papers from the department of applied chemistry at Waseda University.

Something About Water, by A. J. Dotterweich. Published by the Permutit Co., Dollar Savings & Trust Bldg., Pittsburgh, Pa. 24 pages. Price, $.60. An interesting nontechnical explanation of some of the problems encountered in handling water for various purposes. Discusses causes and effects of types of water hardness. The various common chemical impurities found in U. S. waters are treated individually from standpoints of their effect and methods of removal.

Simplified Methods for Computing Stresses in Rigid Frame Buildings, by Sheldon A. Keast. Published by Lefax, Inc., 9th & Sansom Sts., Philadelphia, Pa., 40 pages, $1. A handy pocket-size data book containing simplified methods for computing stresses due to vertical and lateral loads in multi-storied buildings. Intended for the experienced designer with the thought of reducing mathematics to a minimum.

The Story of Vitamin B_1. Published by Merck & Co., Rahway, N. J. 55 pages. Not intended for general distribution but available to qualified individuals, this booklet discusses vitamin B_1 from the standpoints of its isolation and synthesis, properties, assay, physiological action, effect on diet and nutrition, and clinical manifestations and therapy. Vitamin B_1 is the heat-labile, growth-promoting component of the multiple vitamin B complex. The current literature has been reviewed and extensive use made of authoritative source material. The booklet accordingly is an excellent digest of information on this subject.

The Thirty-Year Decline in Commodity Prices, by Allen W. Rucker. Published by the Eddy-Rucker-Nickels Co., Cambridge, Mass. 24 pages, 25 cents. The author of "Labor's Road to Plenty" here discusses long-range price trends, how they are being affected by government credit manipulation, and how the current price decline may be softened by (1) balancing prices with income, wage-rates with open-market prices, (2) developing a group compensation system for labor, and (3) ceasing dependence upon governmental price control schemes. An interesting and well-grounded analysis of the price situation.

Symposium on Accelerated Laboratory Tests and Service Tests on Protective and Decorative Coatings. 49 pages. Available from A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, Pa., 60 cents. Twenty-five technical authorities present in summary form the latest information available on correlation of accelerated laboratory tests and service tests on protective and decorative coatings. Covers wood finishes for interior and exterior service and paints for iron and steel.

Technologie der Zinklegierungen, by Arthur Burkhardt. Verlag von Julius Springer, Berlin W9, Germany. 256 pages, RM 31.50. An interesting treatise covering in detail the more important alloys of zinc. Describes investigations which led to the creation of new commercial zinc alloys. Much valuable technological data included.

MELLOR COMPLETED

TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY, VOL. XVI, PLATINUM AND GENERAL INDEX. By *J. W. Mellor.* Published by Longmans, Green and Co., London and New York. 811 pages. Price, $20.

THE PUBLICATION of this sixteenth volume marks the completion of the huge task which Dr. Mellor set for himself back in 1922 when he brought forth the first volume of his famous treatise. The completed work now represents another milestone in the building of an English chemical literature, and it will serve for many years as a useful monument to its author.

Realizing, however, that time and science wait for no man, Dr. Mellor is already working on two supplementary volumes which will bring the subjects in the previous volumes up to date and will include the results of the most recent research. Arrangements are also being made for a third additional volume on the carbon compounds of hydrogen and nitrogen.

The pages in the present book are divided almost evenly between platinum and a general index which covers the whole series. The platinum section follows the same general style of its predecessors and includes material on history, occurrence, extraction, chemical analysis, physical properties, alloys, and chemical compounds.

AID TO CLEAR THINKING

LABOR'S ROAD TO PLENTY. By *Allen W. Rucker.* Published by L. C. Page & Co., Boston, Mass. 221 pages. Price, $2.50.

Reviewed by *S. D. Kirkpatrick*

HERE is a book that cuts through all the artificiality of managed prices, wages and hours legislation and other arbitrary devices for so-called "social control" of industry. In the practical language of the engineer and plant manager, it shows clearly that the prin-

ciple of "pay proportionate to productivity" can be made to work in an individual business, in a community or in the national economy as a whole. There is nothing new about the idea that the more we produce and sell, the more we can have—it is the basic philosophy of the American system. Yet the author shows clearly that in the past 15 years governmental policy has gradually undermined this system and today we are threatened with serious consequences unless we can return to this fundamental principle.

The value of Mr. Rucker's book to any chemical engineer or industrial executive lies principally in the fact that it will stimulate clear thinking about present and future relationships between labor and management. It is written by a man who knows chemical industry intimately and who, incidentally, has high praise for most of its labor policies.

WORLD MINERAL SURVEY

MINERAL RAW MATERIALS. Prepared by the staff of the Foreign Minerals Division, U. S. Bureau of Mines. Published by McGraw-Hill Book Co., New York City. 342 pages, 65 charts. Price, $5.

Reviewed by *R. M. Lawrence*

THIS ably prepared survey discusses world supplies and movements of the principal minerals and the status of major countries with respect to these basic raw materials.

Part I comprises chapters on 32 minerals. These outline the production methods, operations of deposits, industrial uses, and the competition of substitute materials. Production statistics, charts, and a world map show relative positions of the countries involved in production, consumption, and trade in each mineral.

Part II compares mineral self-sufficiency of the 12 major industrial nations. Individual chapters on these countries describe the problems of obtaining supplies of mineral raw materials and discuss industrial organization with emphasis on the artificial regulation of mineral output and trade. Statistical tables are presented for each nation's mineral production from 1932 through 1934 and imports in 1932 and 1934. The trade figures include alloys, matte, scrap and other products which affect mineral requirements.

All modern nations depend upon international trade for adequate supplies of industrial minerals. The U. S. ranks first as a mineral consumer and is best equipped to produce its own supply, but for requirements of certain vital raw materials must depend upon imports.

This book is impressive for its concise presentation of a large volume of information and will be a valuable addition to the literature of the mineral industry.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Study of Transparent Plastics for Use on Aircraft, by Benjamin M. Axilrod and Gordon M. Kline. Bureau of Standards, Research Paper 1031; 15 cents.

Magnetic Testing, by Raymond L. Sanford. Bureau of Standards, Circular 415; price, 10 cents.

Durability of Some Loose-Fill and Aluminum Foil Insulating Materials. Bureau of Standards, TIBM-59; mimeographed.

Odorous Fumes From Sulphate Pulp Mills. Bureau of Standards, Letter Circular 508; mimeographed.

Sources of Foreign Credit Information. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 292, Sixth Revision; 10 cents.

Check Sheet, Introduction of New Industrial Products, by O. C. Holleran. Bureau of Foreign and Domestic Commerce, Market Research Series No. 6. Revised; mimeographed, 10 cents.

Mine Gases and Methods for Their Detection, by J. J. Forbes and G. W. Grove. Bureau of Mines, Miners Circular 33, Revised June, 1937; 30 cents.

Contributions to the Data on Theoretical Metallurgy—VIII. The Thermodynamic Properties of Metal Carbides and Nitrides, by K. K. Kelley. Bureau of Mines Bulletin 407; 10 cents.

Regulations Governing the Production and Sale of Helium for Medical, Scientific and Commercial Use. Bureau of Mines, unnumbered document; mimeographed. Indicates terms under which the Bureau will shortly be able to offer helium for sale.

Mineral production statistics for 1937—preliminary mimeographed statements from Bureaus of Mines on: bauxite; leads; zinc; copper; iron ore; lead and zinc pigments and zinc salts; lime; cadmium; fuel oil; silver; gold.

Dust Sampling. Bureau of Mines mimeographed reports on: Microprojection Method for Counting Impinger Dust Samples, by Carlton E. Brown and others, R. I. 3373; Bureau of Mines Midget Impinger for Dust Sampling, by J. B. Littlefield and others, R. I. 3360; Petrographic Identification of Atmospheric Dust Particles, by Wilder D. Foster and H. H. Schrenk, R. I. 3368.

Note on a New Ocular Micrometer for Use in Dust Counting, by Richard T. Page. Public Health Service Reprint 1861; 5 cents.

Crude Oil Analyses. Bureau of Mines mimeographed reports of analyses of crude oils from: Some Fields of Pennsylvania and New York, by E. C. Lane and E. L. Garton, R. I. 3385; Some of the More Recently Discovered Rocky Mountain Fields, by Walter Murphy and H. M. Thorne, R. I. 3358; California (Additional Analyses). by E. C. Lane and E. L. Garton, R. I. 3362; Maverick Springs, Wyoming, Release of December 31, 1937.

Survey of Fuel Consumption at Refineries in 1936, by G. R. Hopkins. Bureau of Mines, Report of Investigations 3367; mimeographed.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1937, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines, Information Circular 6977; mimeographed.

Cooperative Fuel Research Motor-Gasoline Survey, Summer, 1937, compiled by E. C. Lane. Bureau of Mines, Report of Investigations 3374; mimeographed.

Sulphuric Acid Extraction Methods for Determining Olefins and Aromatics in Hydrocarbon Oils—Optimum Conditions and Concentrations of Acid, by C. H. Fisher and Abner Eisner. Bureau of Mines, Report of Investigations 3356; mimeographed.

Some Pertinent Information About Mine Gases. Bureau of Mines, Information Circular 6983; mimeographed.

Permissible Methane Detectors. by L. C. Ilsley and A. B. Hooker. Bureau of Mines, Report of Investigations 3359; mimeographed.

Investigations During 1936 of Combustibles in Manholes in Boston, Mass., by G. W. Jones and others. Bureau of Mines, Report of Investigations 3375; mimeographed.

Studies in Nonferrous Metallurgy—Collection of Gold by Iron Abraded in Grinding, by S. R. Zimmerley. *Flotation of Oxidized Silver-Lead Ores as Influenced by Modified Grinding*, by S. R. Zimmerley. Bureau of Mines, Report of Investigations 3364; mimeographed.

Mineral Wool, by J. R. Thoenen. Bureau of Mines Information Circular 6984; mimeographed.

Mines Reports. Brief printed Annual Report of the Director, supplemented by more detailed summaries of various divisions, including: Metallurgical Division, R. I. 3357; Mining Division, I. C. 6973; Technologic Work on Coal, I. C. 6992.

Methods and Costs of Mining and Crushing Gypsum at the Mine of the Ebsary Gypsum Co., Inc., Wheatland, N. Y., by E. J. Lintner. Bureau of Mines, Information Circular 6971; mimeographed.

Employment and Accidents at Metallurgical Plants in the United States in 1935. Bureau of Mines, H.S.S. 249; mimeographed.

Coal-Washing. Bureau of Mines mimeographed reports on: A Pulsator-Type Coal-Washing Jig, R. I. 3372; A Baum-Type Coal-Washing Jig, R. I. 3371, by H. F. Yancey and others.

Active List of Permissible Explosives and Blasting Devices Approved Prior to June 30, 1937. Bureau of Mines, R. I. 3361; mimeographed.

Rules of Practice and Procedure and Laws Relating to the United States Tariff Commission. Tariff Commission, Miscellaneous Series; 10 cents.

Commodity Packaging Data. Tariff Commission, unnumbered document; mimeographed. A guide to current practices in the packaging of typical commodities that move in domestic and international trade.

Flat Glass and Related Products. Tariff Commission Report No. 123. Second Series; 35 cents.

Performance Characteristics of Venturi Tubes Used in Aircraft for Operating Air-Driven Gyroscopic Instruments, by Harcourt Sontag and Daniel P. Johnson. National Advisory Committee for Aeronautics, Technical Notes No. 624; mimeographed.

Annual Report of the Tennessee Valley Authority for the Fiscal Year Ended June 30, 1937; 60 cents.

Anti-Trust Laws, With Amendments, 1890–1937. Document Room, House of Representatives, unnumbered pamphlet; 10 cents.

Instructions for the Operation, Care, and Repair of Compressed Air Plants. Navy Department, Bureau of Engineering, Reprint of Chapter 18 of the Manual of Engineering Instructions, Revised September, 1937; 10 cents.

Lubricating Oil, General Information, Requirements, and Methods of Test. Navy Department, Bureau of Engineering, N. Eng. 31, Revised 1937; 10 cents.

Technology and Planning. National Resources Committee, unnumbered pamphlet; 10 cents.

Alaska, Its Resources and Developments. National Resources Committee, Part VII of Report on Regional Planning; mimeographed.

Supplement No. 1 to Regulations for Transportation by Rail of Explosives and Other Dangerous Articles in Freight, Express, and Baggage Services, Including Specifications for Shipping Containers. Interstate Commerce Commission; 25 cents.

Information on Industrial Alcohol, by W. W. Skinner. Bureau of Chemistry and Soils MC-22, Revised Jan., 1938; mimeographed.

Federal Alcohol Administration. Annual Report to Congress, January 5, 1938, with fifteen exhibits; mimeographed.

Nitrogen-Fixing Bacteria and Legumes, by Lewis T. Leonard. Department of Agriculture, Farmers' Bulletin 1784; 5 cents.

Experiments With Certain Copper Compounds as Bunt Fungicides, by O. A. Nelson and R. W. Leukel. Department of Agriculture Circular 452; 5 cents.

Advertising in Brazil, by J. Winsor Inves. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 838; 10 cents.

Artificial Resin Glues for Plywood. Forest Products Laboratory unnumbered document, revised September 1937; mimeographed. Obtainable from Forest Products Laboratory, Madison, Wisc.

Rate of Flow of Capillary Moisture, by M. R. Lewis. Department of Agriculture, Technical Bulletin 579; 5 cents.

Process Equipment NEWS

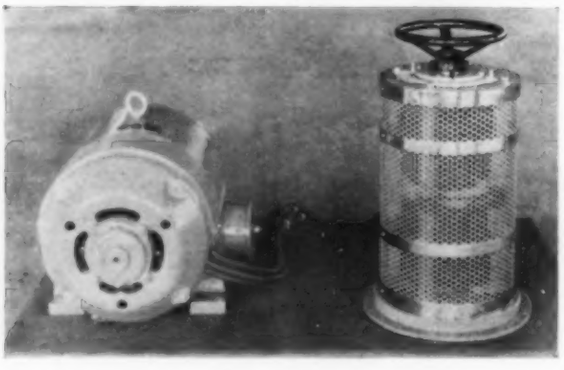
Machinery, Materials and Products

Variable-Speed A.-C. Motor

AFTER SEVERAL YEARS of experimental work, the Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., has announced the successful development of what is said to be the first practical adjustable-speed alternating-current motor. Satisfactory variable-speed direct-current motors have been available previously, but it is claimed that no all-electric method of satisfactory speed adjustability in alternating-current motors has previously been known. The new machine is a three-phase shunt motor said to be capable of stable and easy speed regulation over a wide speed range. The new Polyspeed motor is, in a sense, an ingenious combination of a.-c. and d.-c. motor, of simple, rugged construction, capable of being operated at any speed desired from slightly above standstill to 1,800 r.p.m., simply by turning the rotor of the speed regulator through an angle of 180 deg.

The motor has a stator core and winding similar to an ordinary induction motor and a single rotor winding similar to the armature of a d.-c. motor. It has 50 per cent more brushes than a d.-c. machine of the same number of poles. The brushes are in a fixed position. The speed regulator, which is separate, is of the induction type with no switch contacts. The machine is stated to have constant torque over the entire speed range although in some cases it can be operated on increased torque at higher speeds. The motor is started by direct connection across the line, developing full-load starting torque with little more than full-load current. Ready reversal of rotation is a feature.

New variable-speed a.-c. motor; speed control unit at right



Tank Car Blower

SAID TO BE the first equipment of its kind especially built for this application, the new tank car blower recently announced by the Coppus Engineering Corp., Worcester, Mass., is available for ventilating tank cars and supplying fresh air to men working within. The blower, weighing about 55 lb. and using a ½-hp. motor, is coupled to a nipple at the bottom of the tank car and delivers about 600 c.f.m. of air which is said to be sufficient to provide good working conditions and prevent harm from gases or fumes.

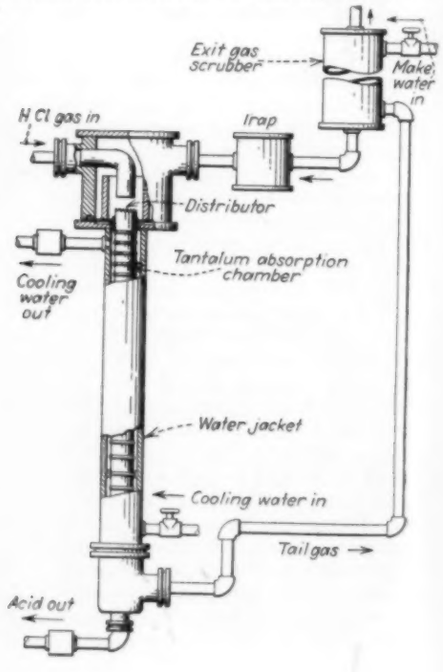
Blower for tank car ventilation

HCl Absorption System

ANNOUNCEMENT of the development of an absorption system for hydrochloric acid, in which a tantalum absorption chamber is used, has recently been made by the Fansteel Metallurgical Corp., North Chicago, Ill. With this unit it is said to be possible to produce acid of any desired concentration up to 24 deg. Bé., in a single pass through the system. Exceptional compactness and the ability to produce acid as pure as its ingredients are important features of this equipment.

As shown in the accompanying drawing, the absorber consists of a water-cooled tantalum absorption chamber, combined with auxiliary equipment for supplying the make water and scrubbing the exit gases. Control equipment of either manual or automatic type may be supplied. The HCl gas, which may be either pure or a mixture with non-condensable materials, is introduced at the upper end of the absorption chamber together with the make water which has already absorbed any HCl remaining in the tail gases. The water trickles down the inner surface of the tantalum absorption tube and the heat of reaction, approximately 1,000 B.t.u. per lb. of HCl gas, is effectively removed by cooling water surrounding the chamber. It is said to be possible to cool to a temperature within 4 or 5 deg. of the cooling water. Using water of 85 deg. F., acid of 19 deg. Bé., can be made continuously. With cooling water at

Partial section of new HCl absorption system



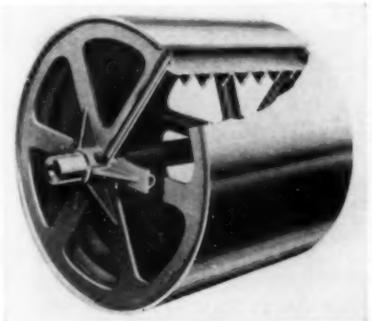
60 deg. F., the production of 24 deg. Bé. acid is said to be readily accomplished. A unit rated at 7 tons of 21 deg. Bé. acid per day occupies no more than 100 cu.ft. of space.

Welded Steel Dryer

FOR USE IN the paper, soap, pharmaceutical and other industries, Lukenweld, Inc., Coatesville, Pa., has developed a new type of welded steel dryer for pressures up to 150 lb. of steam or other heating medium. The dryer is made in sizes up to 15 ft. in diameter, with shell face width limited only by transportation restrictions. Two constructions are employed: single shell and double shell. In the single shell type, the heating medium circulates within the dryer drum. In the double shell type, steam or other heating fluid is conducted through the trunnion, through channels welded integrally with the spokes and is confined in compartments in the jacket formed between the inner and outer shells. Condensate is automatically and continuously drained through outlet channels welded integrally with the spokes.

Owing to the use of a special close-grained steel, which can be highly polished and, if desired, plated with chromium, the new dryer is said to maintain cleaner drying surfaces. Light weight, uniform drying, lower steam consumption and controlled steam distribution are among the advantages claimed by the manufacturer.

Sectional view of double-shell dryer



Injection Molding Press

MODEL 25 is the designation of a new fully automatic, hydraulically controlled injection molding press that has been introduced by the Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. If desired, the machine can be operated semi-automatically or manually. For full automatic control, the cycle is started with a limit switch which is engaged by the return movement of the clamp ram. For semi-automatic operation, dual starter buttons are provided as a safety factor. Two pilot valves are used for manual operation. Molds are closed by hydraulic power operating directly on the clamp cylinder. A second hydraulic cylinder actuates the extrusion plunger.

In operation the machine clamps the mold halves under direct hydraulic pressure; feeds the material in measured quantities and heats it to plasticity; contacts the plastic material chamber outlet with the mold inlet; extrudes the plastic material from the heated chamber under intensified hydraulic pressure into the mold cavity; opens the mold; and finally ejects the finished article. An electrically heated oil circulating system is provided for heating the thermoplastic material.

Asbestos Suit

MANY NEW FEATURES for the protection of fire-fighters are claimed for a new one-piece asbestos suit recently developed by Johns-Manville Corp., 22 East 40th St., New York City. Owing to the one-piece construction and the zipper closure, the suit is stated to furnish more complete protection and to be quicker to put on. A safety hook is provided, to which a flexible steel cable can be attached to pull the rescuer away from the fire, should he be overcome by the heat. A heatproof glass window is supplied, suspended well away from the face.

New Products

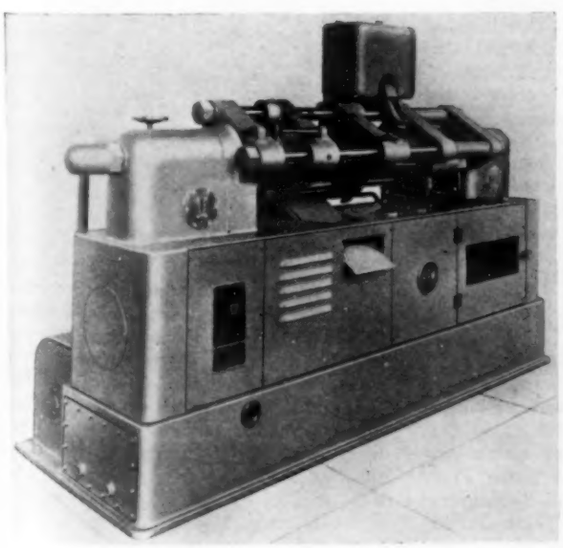
WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., has recently announced several new chemical products including inks for marking on glass, porcelain and metals; a new cement for vacuum furnaces; and etching solutions and pastes for metals and glass. The inks are made in both black and white and are applied with a steel pen. If set by the application of a moderate temperature, they cannot be removed completely by ordinary scraping. A silver ink is also available. The vacuum cement is said to adhere to any surface and can be reused indefinitely. It is solid at room temperature but can be spread with a heated putty knife after heating with a torch. Dissolved in carbon tetrachloride, it can be used as a paint.

A GENERAL PURPOSE hard metal, Tantaloy, has recently been announced by the Fansteel Metallurgical Corp., North Chicago, Ill. This material contains tantalum carbide and although intended primarily for use in cutting tools, is also recommended for other wearing surfaces and in the general field of application of abrasion and corrosion resisting metals.

SNOPAKE is the name of a new coating material for windows that has recently been developed by the Saybrite Co., Cleveland, Ohio. This material is a pale green adhesive liquid intended to be brushed or sprayed on windows in buildings where snow glare from adjacent open areas is objectionable in the winter. This material is claimed to admit over 90 per cent of the light, yet to produce a mellow, softly diffused illumination. It is readily removed with hot water and a bristle brush after the need for its use has passed.

AN IMPROVED polystyrene molding material which has been given the designation XMS-10023 has been announced by the Bakelite Corp., New York, N. Y. It is stated to offer exceptional advantages in electrical products, particularly with regard to low loss factor, low power factor, and high resistivity and dielectric strength. The material is stated to be durable, tough, and highly resistant to corrosion.

PROTECTION for the hands and arms of workers against chemicals, solvents, oils and other harmful



Left—Automatic hydraulic injection molding press

New one-piece asbestos suit

substances is said to be afforded by a new protective cream recently introduced by Davis Emergency Equipment Co., 55 Van Dam St., New York, N. Y. This cream is water soluble and may be readily removed by washing, carrying with it dirt, grease, paint or other materials. A second cream is provided for use after finishing the work of the day to replace the natural oils of the skin. This cream, not being water soluble, may be used by those whose hands are constantly wet with water.

Equipment Briefs

DESIGNED primarily for use in the petroleum and chemical industries and other hazardous applications, a new line of high-voltage, explosion-proof line-starters has been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Through the use of oil immersion, both corrosion resistance and high interrupting capacity are obtained. For starting squirrel-cage and wound-rotor induction motors, these starters are available for 2,200 or 4,600 volt service. Since it is weather-proof, such equipment may be mounted outdoors without protection from the elements.

FOR DETERMINATION of pH in the range from 5.2 to 6.7, as required in the electroplating industry, the Udylite Co., Detroit, Mich., has introduced a paper strip pH indicator which is claimed to give accurate results. The box containing the strips carries a color scale with which comparisons for pH determination can be made. Technical knowledge is unnecessary in securing satisfactory results, according to the company.

ESPECIALLY DESIGNED for refinery service, a new pressure gage employing a stainless steel bourdon tube and a new method of zero adjustment, has been announced by Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, Ill. The instrument is constructed of stainless steel and Monel metal throughout. The zero adjustment is of a special type designed to compensate throughout the range for any distortion of the tube. Special methods of construction are employed in producing and assembling the tube while special care is taken in making the case moisture-, vapor- and dust-proof and corrosion resistant.

TO FACILITATE the cleaning of industrial incandescent lamps and their reflectors without necessitating the use of a ladder, the Benjamin Electric Mfg. Co., Des Plaines, Ill., has developed the new Floor-Service Turnlox hood which permits easy removal of the reflector, globe and lamp from the socket in one quick 90-deg. twist. A light-weight shaft and engaging device known as

New full vision gas mask

the reflector changer permits the operator, standing on the floor, to remove and replace fixtures at heights up to 18 ft. Ease of cleaning is important since it is pointed out that dirt films may absorb from 20 to 60 per cent of the light in many fixtures.

A NEW LINE of high-pressure stop valves in sizes from 2½ to 8 in., for pressures up to 2,500 lb. per sq.in, has been announced by Clees Valve & Engineering Co., 90 West St., New York, N. Y. These valves are produced from a single block of forged steel and are made with either flanged or weld ends, in both angle and offset types, the construction material being chrome molybdenum steel with Stellite-faced seats.

AN ELBOW-PROPELLER type circulating pump for handling capacities from 1,000 to 2,000 g.p.m., with heads up to 20 ft., has been announced by Worthington Pump & Machinery Corp., Harrison, N. J. These pumps are designed both for water and semi-viscous liquids such as sugar juices, paper stock and the like. They are intended for installation directly in pipe lines and feature compact and sturdy construction.

YORK ICE Machinery Corp., York, Pa., announces the new FS-12000 spray type air conditioner for industrial applications of low temperature air conditioning. This unit is designed to handle air volumes up to 16,000 c.f.m. and capacities up to 40 tons of refrigeration.

Full Vision Mask

FULL VISION LENSES affording 90 deg. vertical and 170 deg. lateral vision are a feature of the new full vision gas mask manufactured by the Acme Protection Equipment Co., 2652 Koppers Bldg., Pittsburgh, Pa. These masks

Wide-trough inspection feeder

Section of cord reinforcement for conveyor belts

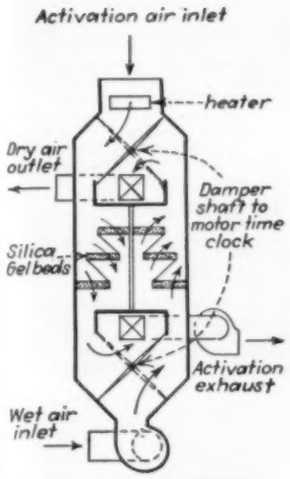
are of the canister type, available both in corrugated tube and snout designs. The light-weight, all-rubber face piece is fully molded and cured to master face-fitting proportions. The design is said to eliminate the build-up of exhaled air in the fresh air ducts. Canisters for organic vapors, acid gases, ammonia, industrial smokes and all military gases and smokes are available.

Inspection Feeder

AN ELECTRICALLY VIBRATED feeder with a wide trough for spreading small objects such as small molded pieces over a wide area for ready inspection has been developed and announced by the Syntron Co., Homer City, Pa. Control of the feeder flow is accomplished by means of a rheostat in a separate wall-mounted controller furnished with the feeder. No moving parts require lubrication.

Cord Conveyor Belts

CONSTRUCTION FEATURING a cord carcass for rubber conveyor belts, similar to the type of cord construction now used in motor car tires, is announced by the B. F. Goodrich Co., Akron, Ohio. Conventional conveyor belt design has hinged on a carcass built up of plies of woven fabric. The new construction substitutes plies of weftless cords, running parallel to the belt, each cord of which is completely surrounded by and



Silica gel dehumidifier

insulated with rubber. This construction is said to produce extreme transverse and longitudinal flexibility, giving greater resistance to moisture and acid penetration and considerably increasing the service life of the belt.

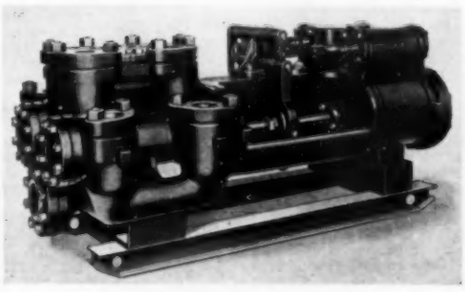
Dehumidifying Equipment

CARRIER CORP., Syracuse, N. Y., announces the addition of silica gel dehumidifying equipment to its line of industrial air conditioning devices. When moisture is brought in contact with silica gel, it will take up 40 per cent of its weight in moisture after which the material is readily regenerated by application of gas heat. Essentially, the equipment consists of a series of silica gel trays, motor driven fans to convey the air to be dehydrated, a gas heater for producing reactivating air, and automatic controls for continuous operation. The new equipment is particularly recommended by the manufacturer for those applications requiring lower than average humidity.

The principle of the new dehumidifier is illustrated diagramatically in an accompanying sketch. Wet air is drawn upward through the silica gel beds, the dried air passing out at the upper end of the equipment. Simultaneously, hot air for reactivation is drawn in above and passed downward through a second series of silica gel beds, being exhausted near the bottom. At proper intervals, automatically actuated dampers change the cycle so that the freshly activated beds become available for air drying while the saturated beds are being reactivated.

Duplex Steam Pump

AN ACCOMPANYING illustration shows a new duplex steam pump with an eight-cover, side-pot type fluid end, and an improved piston valve steam end, which has been announced by Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. This pump, designated as Fig. 6285, is intended for the handling of oil, water and other free-flowing liquids at pressures up to 1,000 lb. per sq.in. and in capacities up to 148 g.p.m.



New duplex steam pump

This company has also developed a new line of duplex power pumps for oilfield and other high pressure service requiring pressures up to 800 lb. per sq.in. and capacities to 187 g.p.m. A third new development is a vertical, close-coupled, motor-driven centrifugal pump of 6 to 60 g.p.m. capacity, for general service in deep or shallow wells, ranging in depth to 200 ft. For depths greater than 20 ft., an ejector and venturi are installed in the tail pipe below the pump, utilizing a part of the water discharged by the pump to lift water to the pump suction.

Simple Humidifier

NO AIR LINES or additional piping are required in the installation of the Grid humidifier, for use in connection with unit heaters, manufactured by the Unit Heater & Cooler Co., Wausau, Wis. The humidifier, which may be attached either in front or directly behind the unit heater, consists of a small steam spray, provided with steam from the heater supply. The humidifier may be operated with the unit heater or by itself, under control of a humidistat.

Measuring Machine

FOR CONTINUOUS MEASUREMENT of bulk material such as coal, coke and sand, the Trump Corp., 440 East Genesee St., Syracuse, N. Y., has recently put on the market a double volumetric feeding device which has previously been in use in the alkali industry. The feeder consists of two rotating tables, rotating in opposite directions so as to discharge into a common chute. A knife about 3½ in. high is adjustable to pare out a measured volume of material from between the table and the supply apron above it. Once adjusted, each table delivers a constant volume continuously.

MANUFACTURERS' LATEST PUBLICATIONS

Alloys. Bridgeport Brass Co., Bridgeport, Conn.—80-page book on Duronze, with information on properties, classifications and uses; much engineering information and many property charts included.

Alloys. Haynes Stellite Co., Kokomo, Ind.—32-page book on Hastelloy high-strength alloys for corrosion resistance, discussing properties, listing performance data and showing applications.

Alloys. H. Kramer & Co., Chicago, Ill.—50th Anniversary catalog covering properties and specifications of brasses, bronzes, nickel-silver and white metals produced by this company.

Bearings. New Departure Division, General Motors Corp., Bristol, Conn.—Booklet R27—Concerns interchangeable bearings, listing competitive ball bearings, and giving corresponding numbers of interchangeable New Departure bearings.

Chemicals. Atlas Powder Co., Wilmington, Del.—64-page 25th Anniversary booklet, handsomely illustrated, briefly discussing the company's history and many of its products.

Chemicals. Glyco Products Co., 148 Lafayette St., New York City—New edition of "Chemicals by Glyco," describing this company's complete line of products and giving formulas and other useful information.

Chemicals. Monsanto Chemical Co., Rubber Service Laboratory Division, Second National Bank Bldg., Akron, Ohio—Booklet on rubber antioxidants with particular reference to Santoflex B, listing many comparative data.

Chemicals. The Quaker Oats Co., Chicago, Ill.—20-page booklet, "The Furans," describing and giving properties of chemicals derived from oat hulls, with information on uses.

Chlorination. Specialties Engineering & Service Co., Box V, 14th St. Station, Hoboken, N. J.—8-page booklet describing de-sliming of condensers by this company's periodic process of chlorination.

Cleaning. Michiana Products Corp., Michigan City, Ind.—4-page folder describing this company's sand blast gun for cleaning metallic and non-metallic surfaces.

Compressors. Ingersoll-Rand Co., 11 Broadway, New York City—Bulletin 2118—Folder briefly describing industrial compressors and vacuum pumps, Type 30, ranging in size from ¼ to 15 hp.; Catalog 3426, 56 pages on Class PRE electric-driven, direct-connected compressors in sizes from 200 to 3,000 hp.; describes equipment and illustrates numerous applications.

Conveyors. Mathews Conveyor Co., Ellwood City, Pa.—32-page book, "Natural Laws Applied to Production," presenting an interesting discussion in eight sections of the effect of natural laws on production, with particular reference to materials handling, types of

equipment, basic elements of conveyors, and complete conveying systems.

Coolers. Griscolm-Russell Co., 285 Madison Ave., New York City—Form 710—Leaflet describing this company's Multiwhirl cooler for a variety of applications.

Crushers. Nickle Engineering Works, Saginaw, Mich.—4-page folder describing this company's two-roll crusher-feeder, with information on comparative performance.

Dicalite. The Dicalite Co., 120 Wall St., New York City—16-page booklet on the production of diatomaceous silica in this company's plants, its properties and uses.

Dust Collection. W. W. Sly Mfg. Co., Cleveland, Ohio.—8-page booklets, "Dust Storms" and "Picking Profits out of the Air," briefly describing need for and advantages of dust collection. Also Bulletin S-88, describing this company's blower for helmet air supply; and Bulletin S-81, 4 pages on air helmets for use in dusty atmospheres.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1155-A—20 pages on a variety of motor generator sets, describing equipment in detail and illustrating applications.

Electrical Equipment. Century Electric Co., St. Louis, Mo.—Form 1066—4 pages describing automatic-start induction polyphase motors.

Electrical Equipment. Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.—Bulletin 251—8 pages describing in detail this company's new Polyspeed variable-speed alternating-current motor.

Electrical Equipment. Fairbanks, Morse & Co., 600 South Wabash Ave., Chicago, Ill.—Bulletin 2260—8 pages on a variety of d.-c. motors in sizes up to 200 hp.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA 2450A—12-page booklet describing Type AE-1 air circuit breakers for industrial and other service.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Publications as follows: Bulletin B2130, 12 pages on the selection of electric drives and control equipment with information on maintenance; B2118, 8 pages on protection of starters against explosion and corrosion hazards; Price List 15-010, 8 pages on heavy duty push-buttons; F8408, 4 pages on heavy duty industrial lighting; F8409, 4 pages on high intensity mercury vapor lighting.

Engines. Troy Engine & Machine Co., Troy, Pa.—Bulletin 101—11-page book covering performance records and power costs in more than 40 installations employing steam engines.

Engines. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin S-550-B4C—8 pages on vertical, four-cycle gas engines with complete specifications and typical installation views.

Equipment. Buffalo Foundry & Machine Co., Buffalo, N. Y.—Bulletin 310—56-page catalog on this company's wide range of evaporators, illustrating and describing various types and presenting engineering data. Covers several new designs.

Equipment. The Duriron Co., Dayton, Ohio.—Illustrated booklet on steam jets, ejectors, tank outlets and spray nozzles with selection chart for heating jets, and capacity tables.

Equipment. Homogeneous Equipment Co., Downingtown, Pa.—4-page folder illustrating a variety of homogeneous lead covered equipment, typical of types lead covered by this company.

Equipment. Haveg Corp., Newark, Del.—Bulletin B-1—8 pages giving technical information on standarized cylindrical tanks, covers and outlets, made of Haveg.

Equipment. Patterson Foundry & Machine Co., East Liverpool, Ohio—8-page booklet describing a variety of laboratory and pilot plant equipment, including pebble mills, mixers, autoclaves and other grinding and mixing equipment.

Equipment. The Pfaudler Co., Rochester, N. Y.—4-page brochure illustrating this company's plants, and referring to recent capacity increases.

Expositions. Exhibitors' Advisory Council, 330 West 42d St., New York City—22-page list of shows and exhibits to be held in 1938, classified by types and subjects; price $5.

Gas Absorbers. The Turbo-Mixer Corp., 247 Park Ave., New York City—Bulletin 61—Describes principles of contacting gases and liquids, with reference to this company's Turbo-Gas-Absorbers; Bulletin 65, discusses Turbo-Gas-Absorbers for experimental use.

Grinding. Paul O. Abbé, Inc., Little Falls, N. J.—20-page booklet on ball and pebble mills, with information on types, performance, determination of suitable conditions, milling practice, grinding media, linings and features of mill design.

Heaters. Howard Iron Works and Alberger Heater Co., 281 Chicago St., Buffalo, N. Y.—Bulletin 200—35 pages with descriptions and engineering data covering a wide variety of Alberger heaters; includes alignment chart for determining correct size of pipe.

Hose. Packless Metal Products Corp., Long Island City, N. Y.—Bulletin 100—Engineering data file on this company's seamless flexible metal hose, detachable couplings, vibration snubbers for pipe, and self-draining hose for platen presses.

Instruments. Ashton Valve Co., 161 First St., Cambridge, Mass.—Catalog 38G—32 pages on industrial pressure gages in a variety of indicating and recording types.

Instruments. The Bristol Co., Waterbury, Conn.—Bulletin 496—Describes recorders for electrical unit measurements, discussing applications in industrial fields.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Catalog 1101D—30 pages on this company's photoelectrically balanced pyrometers, covering various types for indicating, recording and control with information on construction and application.

Instruments. Crosby Gage & Valve Co., 30 Church St., New York City—12-page reprint of article on measurement of pressure, by N. J. Smith; also 4-page folder describing vapor-tension gages for petroleum industry.

Instruments. Mercoid Corp., 4201 Belmont Ave., Chicago, Ill.—Catalog 100-F—Revised condensed catalog of 32 pages, covering this company's line of automatic controls for heating, air conditioning, refrigeration and industrial applications.

Instruments. Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.—Bulletin 52—7 pages covering this company's venturi and orifice type flowmeters.

Materials Handling. Service Caster & Truck Co., Albion, Mich.—21-pages describing this company's portable elevators and stackers.

Metal Spraying. Stevens Metal Spraying, Inc., 83 Shipley St., San Francisco, Calif.—8-page booklet describing this company's new metal spraying gun, briefly describing the gun, its principles and application.

Metal Spraying. Metallizing Engineering Co., 44 Whitehall St., New York City—16-page reprint of an engineering article on metal spray surfaces in relation to lubrication.

Mixers. U. S. Stoneware Co., Akron, Ohio—Leaflet describing this company's chemical stoneware Cyclonaire mixers; also Tornadic portable mixers.

Mixing. Mixing Equipment Co., Rochester, N. Y.—4-page folder describing side-entering agitator units with particular reference to this company's new "Bearing Guard" mixer.

Neoprene. E. I. duPont deNemours & Co., Wilmington, Del.—Vol. 1, No. 1, "The Neoprene Notebook," a new publication giving engineering and other information on the applications of neoprene.

Oil Heating. Parks-Cramer Co., 1102 Old South Bldg., Boston, Mass.—Bulletin 138—72-page manual on industrial heating by oil circulation using the Merrill process, with descriptions of typical uses, many illustrations and layout drawings. Section on heat transfer is included.

Pipe Lines. American District Steam Co., North Tonawanda, N. Y.—Bulletin 35-67A—8 pages describing this company's tile conduit and insulation for underground steam and hot water lines.

Pipe. Michigan Steel Castings Co., Detroit, Mich.—Bulletin C-3—10-page bulletin on this company's centrifugally cast pipe and tubes of corrosion resisting steels, with information on properties, sizes, weights and special shapes.

Power Transmission. Baldwin-Duckworth Chain Corp., Springfield, Mass.—"Dossier A-3"—No. 3 in a series on the extraordinary adventures of A. Balduck, the engineering detective, who this time solves a power transmission problem in connection with hammer mills.

Power Transmission. Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog 68—12-page booklet describing in detail this company's line of JFS variable speed transmissions, including new motorized and differential units.

Proportioning. D. W. Haering Co., 3408 Monroe St., Chicago, Ill.—24-page book, "The Art of Proportioning," a new edition of this company's proportioning equipment catalog, covering in 20 pages a variety of hydraulic-piston proportioning and feeding equipment.

Pulverizers. Pulverizing Machinery Co., Roselle Park, N. J.—32 pages on this company's Mikro-Pulverizer, describing various types, discussing application to certain materials, and giving performance data.

Pumps. Morris Machine Works, Baldwinsville, N. Y.—Bulletin 167—4 pages describing a straight-flow type of centrifugal pump made by this company for large-capacity, low-head pumping in capacities above 1,500 g.p.m.

Regulators. Spence Engineering Co., 75 West St., New York City—20-page catalog and handbook, covering a variety of regulators such as pressure regulators, back pressure valves, pump governors, combustion control regulators, and their accessories; includes engineering data to assist selection.

Respirators. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Leaflet describing a permissible respirator for protection against dust particles as small as 1 micron.

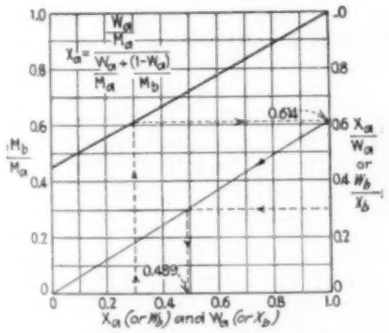
Rubber Goods. The Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.—47-page plastic bound catalog of industrial rubber goods, describing conveyor and transmission belting, industrial rubber hose and other items including hose couplings, rubber-covered rolls, packing, gaskets and other specialties.

Your Plant NOTEBOOK

CONVERSION FROM WEIGHT TO MOL FRACTION WITH EASE AND ACCURACY

By J. S. BAKER
Chemical Department
E. R. Squibbs & Sons, Brooklyn, N. Y.

IN CHEMICAL engineering problems, when working with a binary system made up of pure substances A and B, whose molecular weights are M_a and M_b respectively, it is often necessary to convert weight fractions to mol fractions and *vice versa*. If the weight fraction of substance A is W_a and its mol fraction is X_a, then X_a is given by the equation shown on the sketch below.



Simple graphical method for mol fraction—weight fraction conversion

To obviate the necessity of this cumbersome calculation, the author has worked out the following simple, graphical solution. (See footnote for references to previous methods.) First, a square is constructed on any ordinary graph paper with a side of sufficient length to obtain the desired degree of accuracy. Three sides of the square are then graduated from 0 to 1 and labeled as shown.

The scale on the lower side serves two functions: On it are provided both the initial readings and the result. In addition, the designation appended to the lower and right-hand scales varies depending on the direction of conversion.

Next, a line is drawn from the point on the left ordinate at which the ratio of molecular weight falls, to the point 1.0 on the right ordinate. This line will, of course, remain unchanged so long as the components of the system remain unchanged.

Now, to convert from mol fraction to weight fraction, the value of X_a is located on the lower scale, followed upward to the diagonal and across to the right ordinate. The value thus found is X_a/W_a and W_a may be easily found by dividing this value into X_a by means of the slide rule. However, this may also be done graphically as follows: A diagonal is drawn from the point already found on the right ordinate to the zero point on the left ordinate; then the value of X_a is found this time on the righthand scale, followed across to the newly drawn diagonal and down to the lower scale. This is W_a, the result desired.

To perform the reverse operation, that is to convert from weight fraction to mol fraction, the given value of W_a is subtracted from 1 to find W_b. This value is located on the lower scale, and a procedure exactly like that described above is followed to get X_b as a result, on the lower scale. Then, of course, X_a may be easily found by subtracting this value from 1.

Example—If the mol fraction of potassium iodide in a mixture with potassium chloride is 0.3, what is its weight fraction in the mixture?

$M_b = 74.56$, $M_a = 166.02$,

Then $M_b/M_a = 0.449$.

A straight line is drawn from 0.449 on the left hand scale to 1.0 on the right hand scale. Following vertically from 0.3 on the bottom scale to the diagonal line and then horizontally to the right hand scale, we get 0.614, which is X_a/W_a. Next, a line is drawn from 0.614 on the right hand scale to zero on the left hand scale. Then from the value 0.3 on the right hand scale, a horizontal line across to the diagonal and a vertical line to the bottom scale gives the result as $W_a = 0.489$.

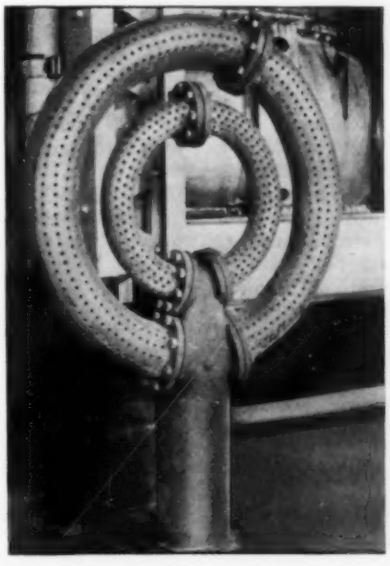
The theoretical validity of this method may be easily proved by setting up the relations between similar triangles in the graph. Combining in one equation and solving for X_a the equation shown on the accompanying sketch is derived.

Weight fraction—mol fraction conversion charts previously published in these pages are those of H. G. Nevitt *(Chem. & Met.*, 39, 1932, p. 673) and C. L. Bridger *(Chem. & Met.*, 44, 1937, p. 451).

Saving Steam With Copper "Pretzel"

A SAVING of 17,000 lb. of live steam per hour was realized by the Pennsylvania Sugar Co., Philadelphia, by utilizing exhaust steam in a beer still. This economy was made possible by the installation of a sparger commonly called a "pretzel," pictured below. Made up of 6- and 8-in. copper tube, it has 866 ⅛-in. holes and cost $1,805.42 with control valves. By means of the "pretzel," 700,000 lb. of exhaust steam is recovered per day, the equivalent of 800 hp.

Sparger for saving steam in a still



Chemical Engineering NEWS

CANADIAN CHEMICAL CONVENTION WILL ATTRACT INTERNATIONAL INTEREST

One of the largest gatherings of chemists ever assembled in Canada will meet in Ottawa in June, when the annual meeting of the Society of Chemical Industry, the British industrial chemical society, will be held in conjunction with the twenty-first Canadian Chemical Convention. A large party of British chemists, including representatives of government technical departments, professors and industrialists, headed by Lord Leverhulme, Governor of Lever Brothers, Ltd. and of Uni-Lever, Ltd., will visit Canada on this occasion and they will be joined in Ottawa by many chemists from the United States. Canadian chemists from all parts of the Dominion will be the hosts of the British and American visitors.

Other prominent British visitors will be, J. Davidson Pratt, general manager of the Association of British Chemical Manufacturers, Dr. L. Jordan, director of the British Paint Research Laboratories, Foster Sproxton, one of the leading British authorities on plastics, who will deliver the Jubilee Memorial lecture; Dr. L. H. Lampitt, chief chemist of Messrs. Lyons, and W. A. S. Calder, a director of Imperial Chemical Industries.

The meetings in Ottawa extend over three days, June 20 to 24. Technical sessions will be held each morning. Visits to plants and to places of interest around Ottawa and various social functions also are on the program. Dr. L. H. Baekeland, the well known American industrial chemist, inventor of bakelite, velox photographic paper and many other important chemical developments, will be the recipient of the Messel Medal and Prof. Marston T. Bogert, Professor of Chemistry at Columbia University, New York, also will deliver an address. There will be a symposium on "The Utilization of Canada's Natural Resources through Chemical Research," at which several prominent industrialists and chemists will present summaries of the great advances made in the last ten years in the production of chemicals and related products derived from Canadian fields, forests, mines and water powers.

Papers dealing with road and building materials, foods, industrial and chemical engineering developments will be presented at sectional meetings, as well as accounts of the latest research in pure chemistry and biochemistry in Canada.

In addition to the meetings in Ottawa, the British party accompanied by many American and Canadian chemists will visit some of the chemical centers and principal cities in Eastern Canada. From Quebec, where they land on June 17, they proceed to Shawinigan Falls and then to Ottawa. After the Ottawa meeting, the party will visit Sudbury, Toronto, Port Hope, Kingston, Hamilton, and Niagara Falls, where they will be entertained by the American Section of the Society of Chemical Industry and the local section of the American Institute of Chemical Engineers. From Niagara Falls, they travel to Montreal, spending three days inspecting places of scenic and technical interest in the neighbourhood, before they return to Great Britain, July 1. Opportunities will be afforded to those unable to attend the Ottawa meeting to meet the British visitors at the various places visited.

Conference on Packaging, Packing and Shipping

Details of the 8th Conference on Packaging, Packing and Shipping, to be held at the Palmer House, Chicago, March 22-25, concurrently with the 8th Packaging Exposition, are announced by the American Management Association, sponsoring organization for the conference and exposition.

A total of 54 outstanding national authorities will discuss important current problems in packaging, packing and shipping.

The exposition will be the largest of its kind held in the country, with some 75 companies presenting outstanding developments in machinery, equipment, supplies and services. A featured display will be a showing of all packages entered in competition for the 7th Irwin D. Wolf Awards.

On Thursday morning, March 24, a session on bulk packaging will open under the direction of R. W. Lahey of the American Cyanamid Co., New York. Lawrence Fraiser, Illinois Cooperage Co., Chicago, will discuss Slack Barrels and George Dyer, Pioneer Cooperage Co., Chicago will talk about Tight Barrels. T. P. Callahan will speak on Loading and Staying of Carload Shipments.

In the afternoon, W. B. Thomas, Steel Manufacturers Council, Cleveland, will present three ten-minute papers and lead the ensuing floor discussion on: Interior Coatings for Steel Drums, and other Steel Packages; Advantages of Re-Rolling Expanded Hoops in Sixteen, Eighteen and Twenty Gage Steel Drums; and Precautions Taken By Steel Drum Manufacturers in Checking Steel Sheets for Imperfections.

On Friday, March 25, R. H. Proctor, St. Regis Paper Co., New York, will preside at a session devoted to paper bags. Speakers will include: T. M. Scruggs, Bemis Brothers Bag Co., St. Louis; C. H. Hartman, St. Regis Paper Co., New York; A. G. Clarke, Bagpak, Inc., New York; and H. H. Leonard, Consolidated Packaging Machinery Corp., Buffalo.

Chemist Advisory Council Formed at New York

The Chemist Advisory Council, Inc. has been organized and chartered as a membership corporation under the laws of the State of New York. The incorporators, who are also members of the board of directors of this organization, are: Robert T. Baldwin, Marston T. Bogert, Frank G. Breyer, William W. Buffum, Walter S. Landis, George C. Lewis, William T. Read, Maximilian Toch, and Edward R. Weidlein.

The objectives of the corporation will be to promote the general welfare of chemists and chemical engineers.

About six years ago, a metropolitan emergency committee known as the Committee on Unemployment and Relief for Chemists and Chemical Engineers was formed to alleviate distress among unemployed chemists and chemical engineers. The Chemist Advisory Council, Inc., will take over this emergency committee and will continue its broad objectives permanently as a national organization. Chronic difficulties now existing in the profession will be studied and an attempt will be made to suggest methods of reducing the number unemployed in the chemical industry. The Council will also serve as a fact-finding committee and central registration office for chemists and chemical engineers.

Badger Will Lecture In Germany

Walter L. Badger, manager of the consulting engineering division of the Dow Chemical Co. in Ann Arbor, Mich., has been invited to deliver a series of lectures in Germany under the auspices of the Verein Deutscher Ingenieur and the I. G. Farbenindustrie, A.G. According to his tentative program, he will address the general meeting of V.D.I. in Frankfort in May, the general meeting of the Deutsche Kalteverein in Stuttgart, followed by a week's lectures at the Technische Hochschule at Karlsruhe. Other lectures are scheduled for Munich, Dresden, Brunswick and Danzig.

He will sail with Mrs. Badger and their daughter on May 10, returning to New York in June after a business trip to England for the Dow Chemical Co.

Professor Badger's "Elements of Chemical Engineering", prepared with Professor W. L. McCabe, has been translated into German and is widely used as a text and reference book in Central Europe.

M. I. T. To Set Up New Field Station

A new field station of the School of Chemical Engineering of the Massachusetts Institute of Technology is to be established at the cellulose products plant of the Hercules Powder Co., Parlin, N. J., according to an announcement by Prof. Walter G. Whitman, head of the Institute's department of chemical engineering. The station will be in charge of Prof. Robert G. Gunness, assisted by James G. Baker, and will be one of three operated by the Institute in cooperation with industrial organizations. A building is now being erected at Parlin to house the Institute's staff and students, and to provide quarters for an office, laboratory, shop, library and conferences. Stations at the Eastern Manufacturing Co., Bangor, Me., and at the plant of the Lackawanna Steel Co., Buffalo, N. Y., will be continued. The Institute has been carrying on this type of full-time field educational work in chemical engineering for 17 years.

Chemical Products Bought By P.W.A. 1933-1937

Textiles, chemicals and nonferrous metals and their products were purchased to the extent of $28,723,527 during the four-year program of the Public Works Administration from June 1933 to June 1937.

These goods were among the industrial products necessary to supply the construction needs of more than 26,000 PWA projects in every part of the nation. They comprised a part of the $1,708,685,535 worth of materials ordered in the four-year period.

Purchases of chemicals and allied products amounted to $14,738,044 divided as follows: ammunition and allied products, $1,186,217; miscellaneous chemicals, $473,731; compressed and liquefied gases, $449,738; explosives, $6,585,292; and paint and varnish, $6,043,066.

New York Safety Council Will Meet in April

The Ninth Annual Convention of greater New York Safety Council is scheduled for April 19-21 at the Hotel Astor, New York. A large attendance, probably 8,000 delegates from all parts of the East, is expected because the National Safety Convention for 1937 and 1938 was and will be held in midwestern cities.

A total of 35 sessions on all phases of safety, requiring 162 speakers, all experts in their field, has been arranged. Fifty-seven organizations are acting as cooperating agencies assisting with the Convention.

The annual dinner will be held Wednesday evening, April 20; the dinner of the Institute of Traffic Engineers on Tuesday evening; and during the Convention, various sections of the Council will hold special luncheons. These include the Metropolitan Chapter, A.S.S.E., the Marine and Petroleum Sections, and the Aeronautical Section.

Practically all of the 89 exhibit spaces for safety equipment have been reserved.

First Chemical Congress In Peru

The First Peruvian Chemical Congress will be held in Lima, July 18-23, 1938. The idea of such a congress, the first of its kind ever to be held in Peru, was initiated by the University of Trujillo. Originally it was planned to hold the congress in Trujillo, but the place was subsequently changed to Lima, the capital city of the Republic. The organizing committee is composed of delegates from the Universities of Trujillo, Cuzco, Arequipa and San Marcos, the National Engineering and National Chemical Societies and government departments.

The underlying purposes of the congress are to increase and strengthen the bonds and cooperation between professional and student chemists and to encourage study and research in chemistry with the idea of developing a chemical industry in Peru.

A. C. S. Semi-Annual Meeting At Dallas

Chemistry of the Southwest, including developments in petroleum, potash, and sulphur, will be featured at the four-day semi-annual meeting of the American Chemical Society, to be held in Dallas, Tex., April 18 to 21, with leading chemists of the United States participating.

Five special symposia in addition to thirty-five scientific sessions and a general public meeting are scheduled. More than 1,500 scientists representing fifteen professional Divisions of the Society will attend.

The Francis P. Garvan Gold Medal, established to honor women chemists, will be presented to Dr. Emma P. Carr, head of the chemistry department of Mt. Holyoke College, "for researches in physical chemistry, especially on the structure of organic molecules by means of absorption studies in the far ultra violet portion of the spectrum".

Award of the $1,000 A. C. S. Prize in Pure Chemistry to an American chemist under 35 years of age who has done distinguished creative work will be announced during the meeting. The funds for the 1938 prize were given to the Society by Prof. James E. Kendall, head of the department of chemistry at Edinburgh University, Scotland, in appreciation of "the facilities afforded him as a young chemist in America to engage in research work during fifteen years at Columbia and New York Universities."

Henry W. Harper, dean emeritus of the Graduate School of the University of Texas, has been appointed honorary chairman of the meeting. Dr. N. C. Hamner, president of the Southwestern Laboratories, Dallas, has been named general chairman, with Prof. May L. Whitsitt of Southern Methodist University as vice-chairman. Dr. J. L. Whitman of Texas Christian University has been chosen secretary and treasurer of the general committee of the Dallas-Fort Worth Section of the Society, which will act as host to the visiting scientists.

Amendment to Compensation Law Proposed

An amendment to the Workmen's Compensation Law sponsored by Industrial Commissioner Elmer F. Andrews which, on and after July 1, 1943, would put compensation for total disability or death due to silicosis or other dust diseases on the same basis as that for accidental injuries and death, is now before the State Legislature of New York. The bill was presented by Senator Jacob J. Swartzwald and Assemblyman Frederick A. Washburn, chairman of the Assembly Labor and Industry Committee.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

CHEMICAL processing of agricultural materials for farm relief will be the major objective of the Department of Agriculture in four laboratories founded by the Farm Act of 1938. In each of these regional laboratories there will be spent approximately a million dollars a year for the study of surplus crops and means for their more effective utilization, and the development of new products or byproducts therefrom. Thus chemurgy comes into its own on a scale far exceeding anything hitherto attempted by Government or industry.

Official decisions are still to be reached regarding most of the major plans and policies for these new chemical engineering institutions. But the act itself makes certain plans seem rather definite. There will be a laboratory in the East, one in the South, one in the Corn Belt states, and one in the West. The Southern laboratory is certain to have the study of cotton problems as its major job. Since chemical processing is the prime objective, the Bureau of Chemistry and Soils is likely to be the spearhead of the attack. But preliminary administrative consideration is under the direction of Dr. James T. Jardine, Director of Experiment Stations, who represents the Department of Agriculture as a whole.

The law provides that the Department shall cooperate with every other agency capable of usefully participating in the work. But it is not known whether this cooperation will extend to the allocation of funds from the four million dollar allotment, or whether it will represent merely cooperation in planning and exchange of research results.

T.V.A. Battle

Fundamental differences in objectives of the three Directors of T.V.A. have long been observed. These at last resulted during the past month in an open break, with serious charges of irregularity and "dishonesty." Chairman A. E. Morgan spotlighted the whole matter by bringing a variety of charges which neither the White House nor Congress can ignore. The reply by Directors H. A. Morgan and David Lilienthal, released through the White House, is equally pointed.

Senator Norris has continued to seek an investigation by Federal trade commission, which critics say would be a "whitewash." Senators King (Utah) and Bridges (New Hampshire) recite twenty-three claimed irregularities, and demand that Congress do the investigating. As this news goes to press no decision had been reached between these two plans, the former favoring the Lilienthal, the latter Chairman Morgan's, point of view.

Somewhat curtailed appropriations for T.V.A. next year are expected, but no substantial cut in fertilizer activities is likely to follow. The only important criticism of the fertilizer program appears to relate to the price paid for admittedly useful phosphate lands. The fertilizer industry has kept almost altogether aloof, feeling that a political, not an industrial, controversy is involved.

Western Phosphate

Development of Western phosphates, mentioned previously by *Chem. & Met.*, and criticized editorially, was newly pressed during late January by Senator Pope. (See *Chem. & Met.*, October, 1937, p. 587, and February, 1938, p. 86). The staunch New Deal Senator, who is up for reelection this year, has White House support, and the President promised on March 1 to send a message to Congress regarding the importance of phosphate to America and its international significance.

From the Senator's comments, Washington immediately concluded that the President had promised to have T.V.A. use its funds and technical staff for a further investigation of Idaho phosphates, probably to build a furnace plant in the intermountain country to make concentrated fertilizer chemicals.

Trade Complications

International problems of unusual complexity grew in number and urgency during the past month in Washington. Full interpretation is impossible, even by those who have access to all confidential records. But process industry is deeply involved in the following, among others:

1. The Eastward movement of German influence seems primarily a step to secure new mineral supplies. This will establish more vigorous German industry, with consequent new competition for Britain, as well as the United States. The British are reported to have withdrawn their major objections because the Eastern corridor effort of the Reich would relieve both Mediterranean and Colonial pressure on the British navy and preparedness program. Regardless of its other aspects, Washington regards the Austrian coup of Hitler as definitely postponing the Continental military explosion long feared.

2. Internal Japanese difficulties, and unexpectedly persistent Chinese resistance, are believed back of recent hints that Japan might now listen to a naval restriction program. This suggestion comes too late. Washington and London are deaf. They prefer to watch Japan exhaust her surplus militarism in the Orient, rather than to embark on unenforceable disarmament plans.

3. Latin American complications increased. Mexican labor decisions against petroleum company appeals were announced by the Supreme Court, and an authenticated announcement indicates that Mexico may arrange with the Japanese for iron ore and harbor rights on the West Coast of that country. The ore land required for the latter development would be expropriated from American firms, in order to secure ready cash to finance the agrarian program of President Cardenas. Brazilian and Nicaraguan developments were equally unpleasant, but perhaps not of such important significance.

4. Negotiations of a new trade agreement with Great Britain, and a revised agreement with Canada, do not appear to be interrupted by the change in Foreign Minister at London. As the final date for briefs to be submitted at the State Department on process industry commodities was reached, spokesmen of the industries made representations, but fear that they were futile. Further tariff cuts seem inevitable.

5. Washington notes with interest, but without alarm, the proposed extension of the International Rubber Regulation agreement for another five years. The minor alterations contemplated are judged by official Washington to represent little change in prospect as to price or supply of rubber.

Money Troubles

Regardless of intention, a number of the recent official actions of the President and his close advisers have been inflationary. Limitation on sterilized gold will tend to maintain a broader cheap money base. The instruction that R.F.C. is to renew commercial loans, especially to small businesses, makes available at least $1.5 billion. The President has begun again the "talk method" of price increases, but undertakes to distinguish between raw materials, which he would like to see higher, and market-basket goods, which he seeks to protect against rises. Industrial response to these official efforts seems to be small.

GERMANY USES MORE ALLOYS IN MAKING CHEMICAL EQUIPMENT

From Our German Correspondent

ALTHOUGH the efforts of the European "Ireg" (international raw steel export cartel) to secure American cooperation in the regulation of prices and markets are reported to have met with partial success, the chief "Ireg" countries, Germany, England, France, and Belgium are not fully in agreement among themselves in seting steel export prices. As a result of American competition, the countries of the export cartel have finally been forced to reduce prices for certain steels, bringing them about equal with German domestic prices but above French and Belgium domestic levels and below American internal prices. Germany and England are so occupied at home with re-armament that their steel export is only incidental and they do not favor too great price reductions. France and Belgium, who have suffered production setbacks, are more anxious to encourage export and lower prices.

During recent months, Germany has increased her imports of scrap as a result of lower prices for foreign scrap iron. Nevertheless, for German industries, a shortage still persists and recently the "Vereinigung der Westdeutschen Schrott-Verbraucher" was founded in Düsseldorf to acquire all scrap iron in western Germany and distribute it to west German steel concerns according to a monthly key.

In the meantime, attempts are being continued by Germany, the world's second largest steel producer, to replace steel wherever possible and to save metals through increasing their corrosion resistance. Among the various alloys, chromium steels like the V.F., the Deutro, and Remanit with 12-16 per cent chromium are being used for chemical equipment. At the Achema, large apparatus including stirring containers, a centrifuge for fatty acids, ammonia, nitric acid, and lye containers were shown. One of the special features of the acid resisting steels shown at the exhibition was the progress made in the welding of these materials.

Cooperation between the German and Japanese iron industry is indicated by the report that a group of large Japanese concerns is planning to erect eight large furnaces using the Krupp-Renn processes.

Because of the importance of magnesium in the Four Year Plan, a "Magnesium Congress" was recently sponsored in Berlin by the "Verein Deutscher Ingeneure". Magnesium is available in Germany in large quantities in carnalite ores, and also the magnesium chloride byproduct of the German potash industry. Germany now supplies one-half of the world's production of magnesium, the durability of its alloys having been increased considerably of late. With its specific gravity of 1.8, it is one of the lightest construction metals and is being used increasingly in the airplane and automobile industries. A number of new magnesium alloys have recently been developed by I. G. Farben and Wintershallen A. G.

To replace metal used for tooth paste tubes, etc., a cooperative enterprise known as the "Thüringer Kumststoff Tubenfabrik G.m.b.H" has just been founded in Schmölln. At present, this enterprise is carrying out experiments in large-scale production of tubes made of rayon, cellophane, and lacquer.

In the field of synthetic fibers, new developments are constantly being reported. Germany, in which the so-called "Lanital", or casein fiber, was originally invented, is becoming interested in this fiber again, after having relinquished the lead in its production to Italy. The Italian "Snia Viscosa" wool, whose qualities were questioned at first, is now licensing factories to use its process in Germany, Poland, France, Belgium, and Holland. The advantage of the "Lanital" fiber is to be found in the fact that it comes closer to resembling natural wool than other synthetic fibers. Italians claim that whereas two years ago lanital had only 10 per cent the strength of natural wool, it has now 85 per cent, and at present it is stated to be possible to produce it at a price cheaper than natural wool.

"Gelsofil" is the name of another synthetic fiber to be produced in Italy from the bark of one and two year old mulberry trees. It is supposed to be twice as tough as cotton but somewhat weaker than linen, and experiments have shown promise in mixing this new fiber with wool and silk as well as cotton.

In Germany, at the beginning of December, the "Kurmärkische Zellwolle und Zellulose A.G." was formed in Berlin at the instigation of the Four Year Plan authorities. The company will build a staple fiber and cellulose factory, which will process rye and wheat chaff in order to help relieve the demands for wood for this purpose.

In the paper and cellulose field, it is reported by Col. Loeb, chief of the German raw materials office, that Germany depends 70 per cent on foreign raw materials. A campaign to exchange coal for burning wood, especially pine, fir, and beech, has released more wood for cellulose manufacture. So far, fir was used only in small quantities in the production of sulphate cellulose, but a number of large-scale experiments have shown new possibilities of using this wood, and several new fir-processing sulphate factories are being built. Beech wood will also be used more extensively for cellulose and staple fiber. A number of plants to process straw are being projected. The reclamation of waste paper is also being intensified and it is hoped to supply the raw materials for a quarter to a third of Germany's paper in this manner.

A process to make paste board out of waste paper and hop grains has been developed by the chief German brewers' organization. The product which is to be used for bill board advertising, consists of 50 per cent hop grains and 50 per cent waste paper. Hindrances to be overcome before this process can find a wider application, are the difficulties of storing the hop grains and also, distance between locations of breweries and paper board factories.

The results of the operations of the first plant for the removal of poison from city gas in the city of Hamlin, Germany, have been published as a sixty-two page monograph, "Gaswerke und Gasentgiftung", by the "Gesellschaft für Gasentgiftung G.m.b.H." Berlin. Costs and practicability, as well as plans for various sized plants for the removal of poisonous gases from municipal gas plants are discussed.

Although never very economical, interest in the utilization of municipal garbage has not declined in Germany, as is evidenced by the number of patents and articles in the newspapers on the subject. Intensive work has been carried on by the city of Berlin under the direction of A. Trirr, who reports that the experiments in making compost and fertilizer have not been overly successful because of the poor garbage material. The reclamation of metals, rags, bones, paper, leather, glass, etc., from garbage yielded 270,000 RM. in Berlin in 1936. The city of Hamburg has been burning garbage successfully to heat steam boilers since 1893. Experiments in the use of gas generated from garbage for heating and running gas motors, although carried on unsuccessfully in Vienna, Stuttgart, and Paris at the beginning of the century, have been taken up again in Berlin. The "Schönberger Müllindustrie A.G." has carried on experiments for several years in smouldering garbage and extracting tar. This tar has been processed to obtain gasoline with anti-knock qualities.

FALMOUTH COMMITTEE DISSECTS PROCESSES FOR PRODUCING OIL FROM COAL

From Our London Correspondent

THE Falmouth Committee which was appointed last April to consider various processes for the production of oil from coal and other materials which are available in Great Britain, as well as to report on the economic possibilities and advantages obtainable by way of the security of oil supplies in emergency, have not made any really startling announcement in their published report. The main conclusions of the committee appear to have been anticipated by those who are already interested in the production of oil from coal. Nevertheless, the report—which has been eagerly awaited—includes much detailed information although it does not disclose any confidential information.

The committee has rejected the claims of low temperature carbonization as an important contributor to the national oil supply. They point out that the commercial value of this process is dependent on the market for the coke which is produced and not on the demand for the byproduct oil. The Scottish shale oil industry, however, is regarded more favorably, even though the solid residue which is left in the retorts is valueless. At coke-ovens and gas-works the production of oil is considered to be merely a minor by-product. So far as the synthetic production of oil is concerned there are only two processes available, namely, hydrogenation and synthesis from a mixture of hydrogen and carbon monoxide, the Fischer-Tropsch process being the only one in the second category upon which the committee has expressed an opinion. That there will be any extension of hydrogenation is somewhat unlikely, because Imperial Chemical Industries has already indicated that it requires considerable financial assistance from the Government before it is willing to make additions to the plant which is in operation at Billingham.

Regarding the Fischer-Tropsch process the Falmouth Report indicates that some considerable measure of government assistance would also be required before any commercial undertaking could contemplate the erection of a plant in Great Britain. They point out that the possibility of a home supply of diesel oil and lubricating oil from the products of the process are especially noteworthy. Compared side by sde, the Fischer-Tropsch process has advantages over the hydrogenation process because plants can be built in smaller economic units and erected at numerous points throughout the coal fields of the country so that they are less vulnerable. No direct subsidy is proposed except for the purpose of assisting research work, but the committee has come to the conclusion that the Fischer-Tropsch process possesses definite valuable features which demand further investigation.

To encourage private enterprise for the erection of plant for the production of synthetic oil it is proposed—in broad terms—that a guaranteed preference on British produced material at 8 pence per gallon be retained until 1950; this is double the present rate of guaranteed preference, and diesel oil for use in motor vehicles is to be included. To establish the utility of the Fischer-Tropsch process the committee consider that it would be necessary to erect a plant for the production of not less than 20,000 to 30,000 tons of primary products per year.

A specific import duty amounting to £3. 5s per ton has been approved for lithopone in place of the existing duty of 20 per cent ad valorem. In Great Britain the production of lithopone is mainly in the hands of three firms. Imports from all countries have increased from 10,380 tons in 1935 to 15,640 tons in 1937.

The chemical section at the British Industries Fair provided its usual display of new products, which are never outstanding in number but generally of special interest. Included among the new products this year is sodium alginate a reactive colloid in highly purified form which possesses useful properties for the control of viscosity. Some new camphor-sulphonates, nicotinic acid for use in the prevention and cure of pellagra, plant hormones such as beta-indolyl acetic acid, and 2:4-dihydroxyacetophenone as a starting point for the synthesis of a number of coloring matters allied or identical with those found in the vegetable world, were other products exhibited for the first time; the last-named product is suggested as a new reagent for the detection of iron. Among new analyticals are N-phenyl-anthranilic acid, sodium diphenylamine sulphonate, diphenylamine sulphonic acid, and naphthidine all exhibited as oxidation-reduction indicators.

CALENDAR

AMERICAN CERAMIC SOCIETY, New Orleans, La., March 27–April 2.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18–21.

FARM CHEMURGIC CONFERENCE, fourth annual meeting, Omaha, Neb., April 25–27.

ELECTROCHEMICAL SOCIETY, Savannah, Ga., April 27–30.

TENTH INTERNATIONAL CONGRESS OF CHEMISTRY, Rome, Italy, May 16–21.

AMERICAN PETROLEUM INSTITUTE, mid-year meeting, Wichita, Kansas, May 23–25.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, White Sulphur Springs, W. Va., May 9–11.

SOCIETY OF CHEMICAL INDUSTRY, annual meeting of all sections, Ottawa, Canada, June 20–22.

Trend in Union Membership Of White-Collar Workers

A significant trend in union membership of white-collar organizations is disclosed in recent advices of the Federation of Architects, Engineers, Chemists and Technicians (C.I.O.) which cite its growth among employed personnel. Originally the membership was drawn principally from unemployed and WPA (see *Chem. & Met.*, Feb. 1938), but figures compiled by F.A.E.C.T. late last fall and just released show the unemployed section to represent only some 10 per cent of the total; WPA another 5 per cent.

Although the present recession has changed the percentages, labor observers place considerable importance on the showing made by F.A.E.C.T. among employed personnel, as an indication of its staying powers. Business management circles are watching two developments: the campaign to affiliate the Society of Designing Engineers with the F.A.E.C.T. on an autonomous basis, and a like campaign among the independent engineering and draftsmen's union at the Allis-Chalmers plant in Milwaukee. Referenda will be completed by April 1, and if both go through the F.A.E.C.T. membership will rise to around 10,000. It then would be in stronger position to organize chemical plants, in conjunction with the drive being pushed by the chemical workers section of the United Mine Workers.

PERSONALITIES

✦ THOMAS C. ATCHISON, formerly in the new products division of the USL Battery Corp., is now chief chemist of the Bright Star Battery Co. of Clifton, N. J.

✦ LEO H. BAEKELAND has been elected to receive the Messel medal for 1938. This medal is awarded by the Society of Chemical Industry every two years for outstanding achievement in science. The only other American to receive it is Dr. R. A. Millikan, Nobel prize winner in physics.

✦ JEAN BILLITER, co-inventor of the Billiter-Leykam caustic cell, has returned to his consulting practice in Vienna after an extended visit in this country.

✦ WALTER H. BRUCKNER has been appointed metallurgical engineering research associate in the engineering experiment station of the University of Illinois.

✦ C. C. CONCANNON, Chief of the Chemical Division of the Department of Commerce, has been appointed chairman of the American delegation to the Tenth International Congress of Chemistry to be held in May in Rome, Italy.

✦ GERALD M. COVER, has been appointed associate professor of metallurgy at Case School of Applied Science. Dr. Cover was formerly in the research department of the National Steel Corp.

✦ A. G. DEEM of the du Pont Ammonia Division at Wilmington, Del., has been appointed assistant professor of chemical engineering at the University of Illinois.

✦ W. R. FERGUSON, formerly with the Owens-Illinois Glass Co., A. J. METZGER, formerly with the Charles Taylor Sons Co., and M. F. TARNOPOL, of the faculty of Pennsylvania State College, have been added to the technical staff of the ceramics division of Battelle Memorial Institute, Columbus, Ohio.

✦ R. A. HENDRICKSON has been appointed manager of the oil sales section of the Crane Co., Chicago. For many years Mr. Hendrickson had charge of the design of the company's products for the oil industry.

✦ GUY C. HOWARD, chemical engineer for the Marathon Paper Mills, left on February 9 for two months visit in Europe, where he will investigate developments in the cellulose industry.

✦ DONALD E. JARMAN, formerly with the Dow Chemical Co., is now with the Sharpsville Boiler Works Co. in the technical service division.

✦ PHOEBUS A. LEVENE of Rockefeller Institute received the 1938 Nichols Medal from the Society for Chemical Industry for his work on the configurational relationships of the simpler optically active organic compounds.

✦ JOSEPH A. MESSENGER, formerly of the United Engineers and Constructors, Inc., has been appointed general manager of the Buell Engineering Co., Inc. Mr. Messenger will be located in the company's New York office.

✦ ROBERT PLATT, chemical engineer, has been appointed Chicago territory representative for F. J. Stokes Machine Co.'s chemical processing equipment.

✦ EDGAR M. QUEENY, president of the Monsanto Chemical Co., is a national vice-president of the National Association of Manufacturers, for the year 1938.

✦ MARVIN C. ROGERS, formerly in the research laboratory of the Standard Oil Co. of Ind. at Whiting, Ind., has been appointed assistant professor of chemical engineering at the University of Minnesota.

✦ NORMAN G. SIXT, chemical engineer from Rensselaer Polytechnic Institute, is chief chemist for the newly established Carolina Analytical Laboratories at Charlotte, N. C.

✦ J. H. TOULOUSE, chemical engineer with the packaging research division of the Owens-Illinois Glass Co., has been appointed chairman of the committee of foods, except milk, of the foods and nutrition section of the American Public Health Association.

✦ J. C. WARNER, former associate professor of metallurgy at Carnegie Institute of Technology, has been appointed professor of chemistry and head of the department of chemistry at that institution.

✦ FREDERICK W. WERNER has been appointed assistant to vice-president C. C. McKaig of the United States Steel Corp., and will have charge of sales of byproducts. Mr. Werner is a former chief chemist of the Illinois Steel Co. and lately has been in charge of coke and byproduct activities of the United States Steel Corp.

N. E. Van Stone

✦ N. E. VAN STONE, recently-appointed director of manufacturing operations of the Sherwin-Williams Co., Cleveland, Ohio, has now been elected to the position of vice-president of that company.

✦ ROBERT N. WENZEL, is in charge of the newly established Westinghouse Fellowship at the Mellon Institute for the study of problems in the field of dielectrics and electrical insulation.

✦ ROBERT R. WILLIAMS, chemical director of the Bell Telephone Laboratories, New York, N. Y., has been awarded the Willard Gibbs medal of the Chicago Section of the American Chemical Society in recognition of his outstanding work in the study and isolation of Vitamin B_1.

OBITUARY

✦ HERBERT R. BROWNE, technical director of the Michigan Alkali Co., at his home in Wyandotte, Mich., Jan. 19.

✦ HARRY S. CALVERT, vice-president in charge of the Elyria division of the Pfaudler Co., Jan. 5, Elyria, Ohio.

✦ CHARLES P. REES, vice-president in charge of mining operations, Vanadium Corp. of America, Jan. 19, Yonkers, N. Y.

✦ OTTO E. RUHOFF, chemical engineer for the Marathon Battery Co., Jan. 5, Wausau, Wis.

✦ REINHARDT THIESSEN, research chemist at the Pittsburgh station of the Federal Bureau of Mines, Jan. 30.

Chemical ECONOMICS and MARKETS

CHEMICAL PRODUCTION AND CONSUMPTION HOLD BELOW LAST YEAR'S LEVELS

OPERATIONS at manufacturing plants failed to show any improvement in January compared with the preceding month according to the Federal Reserve Board. The preliminary index of the Board places the unadjusted figure for manufacturing production at 75 for January which is the same as that reported for December. On an adjusted basis, however, the index numbers are 79 for December and 76 for January.

Index numbers for operations in February are not yet available but reports from some of the most important manufacturing groups indicate that activities were lower than they were in January. Early March reports were of a more encouraging nature with a stepping up in production schedules in steel, automobiles, and some of the larger chemical-consuming industries.

The movement of manufactured goods from plants of origin, apparently was below the production level in January as the stock index for all manufactures was reported at 120 which compares with a revised index of 115 for December. Stocks of chemicals showed an appreciable gain, the index numbers being 164 for December and 173 for January. On the other hand, stocks of chemical raw materials declined from a rating of 124 in December to 118 in January.

From the data shown in the accompanying tabulation it is evident that some branches of the chemical industry were on an ascending curve in January. For instance explosives, paint and varnish, wood rosin, and nitrocellulose plastic production moved up from the low point reached in December. Consumption of chemicals in the textile field also was larger with a slight increase in the cotton branch and more substantial gains at silk and woolen mills.

The comparison for January with the corresponding month of last year does not present an attractive picture. Among the commodities or industries enumerated, only synthetic methanol had a record of completing the first month this year with an output higher than that attained in January 1937. With the exception of explosives, the position of other commodities and industries was sharply below that of the opening month of a year ago. With large percentage declines in such industries as textile, rubber, paint and varnish, plastics, and automotive, it is probable that somewhat similar declines were registered in the volume of chemicals consumed in those industries. Improvement in March may place first quarter totals on a more favorable level but in any event the showing will be all in favor of the 1937 quarter.

According to a composite view of purchasing agents who comprise the Business Survey Committee, buying policy must be based on opinion concerning the trend of business affairs during the next few months and the resulting movement of commodity values. It is the contention of some folks that uncertainties are most likely to remain great for the balance of the year and as a consequence commitments ahead under these conditions are a hazardous undertaking. Then again, there is the opinion that an improvement in conditions abroad, and any sound news pertaining to the industrial picture in this country would rather quickly be reflected in a state of betterment in the Amercan price structure.

However, it is rather difficult to see how prices can be expected to move forward very quickly, even though in many instances low levels have been reached and good buying zones possibly available. It is true that the bullish condition of a year ago was overdone and that the opposite type of market now in effect may be overstayed, but the lack of any significant features within commercial circles that would indicate any nearby change for the better would tend toward the suggestion that most conservative buying policy still be continued until there is more assurance that the bottom of the decline has been reached. Regulatory features may have considerable bearing on numerous commodity markets as the year proceeds further, but on the whole these factors give way to the actual supply-demand ratio of most materials. Consequently, while it may not be expected that radical price recessions are in prospect, it would seem advisable to withhold purchases of more than requirements for current needs at this juncture.

Manufacturers' sales during January 1938 fell off 29 per cent from January 1937, according to reports from manufacturers cooperating in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce. Without adjustment for seasonal influences, January sales declined 6 per cent from December 1937.

For the chemical and allied products group a drop of 20 per cent from the total for January 1937 was indicated but the group showed a rise of 7.8 per cent from last December. Paints and varnishes were reported at a decline of 25.4 from January 1937 but at an advance of 31.8 per cent over last December.

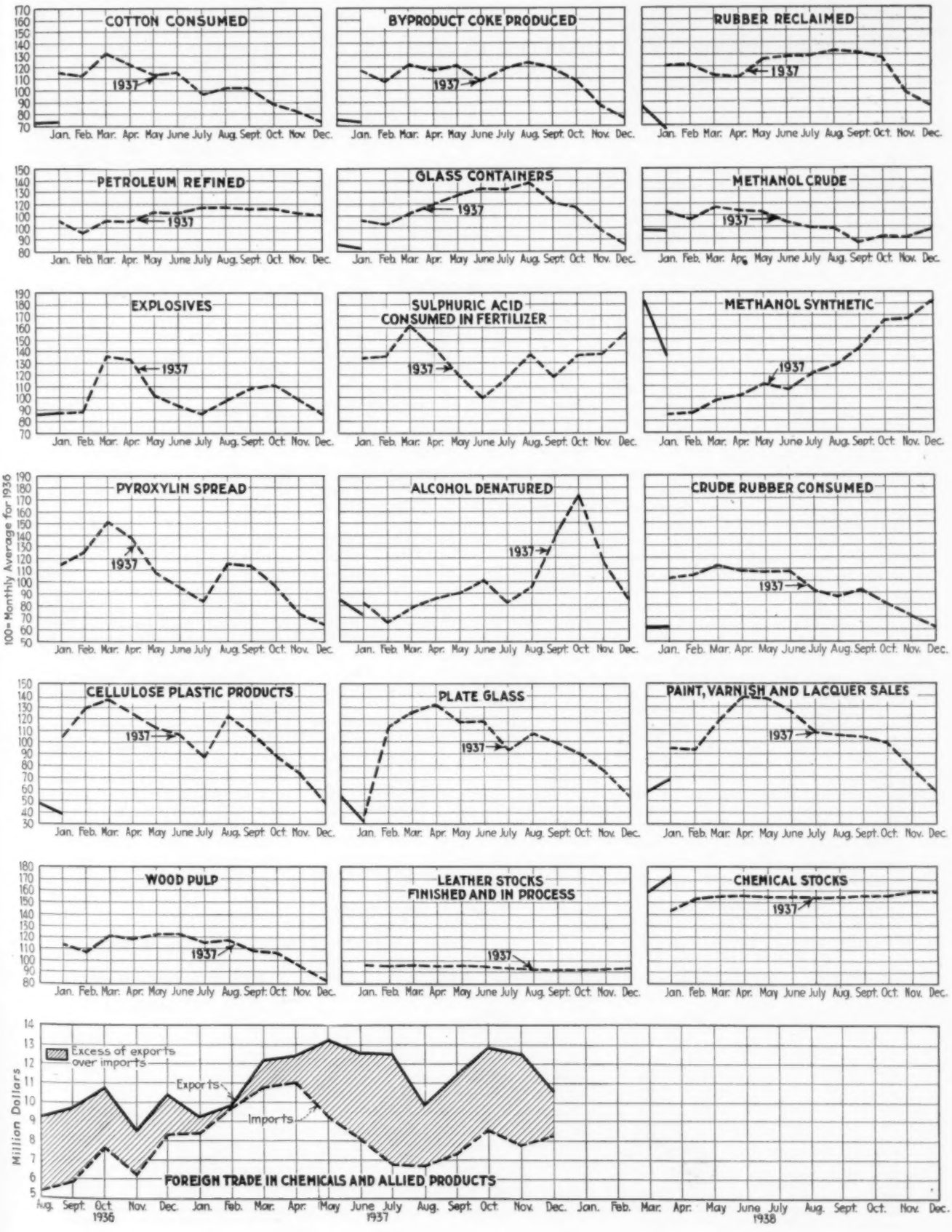
Production and Consumption Data for Chemical-Consuming Industries

	Jan. 1938	Jan. 1937	Dec. 1937	Per cent of decline Jan. 1938 from Jan. 1937	Per cent of decline Jan. 1938 from Dec. 1937
PRODUCTION					
Alcohol, ethyl, 1,000 per gal	15,847	18,705	17,263	15.3	8.2
Alcohol, denatured, 1,000 wi. gal	5,883	6,807	7,012	13.6	16.1
Automobiles, number	210,450	380,055	326,234	44.6	33.5
Byproduct coke, 1,000 tons	2,762	4,358	2,829	36.6	2.4
Glass containers, 1,000 gr	3,125	4,039	3,235	22.6	3.4
Plate glass, 1,000 sq. ft	5,119	6,373	8,921	19.7	42.6
Methanol, crude, gal	458,347	525,070	461,539	12.7	0.7*
Methanol, synthetic, gal	2,896,894	1,835,815	3,887,741	57.8*	25.5
Nitrocellulose plastics, lb	646,374	1,714,506	602,477	62.3	7.3*
Cellulose acetate plastics, lb	344,539	853,376	624,078	59.6	44.8
Rosin, wood, bbl	43,228	60,620	42,761	28.7	1.1*
Turpentine, wood, bbl	6,958	9,632	7,450	27.8	6.4
CONSUMPTION					
Cotton, 1,000 bales	435	679	433	35.9	0.5*
Silk, bales	30,715	44,198	21,982	30.5	39.7
Wool, scoured, 1,000 lb	16,381	41,616	13,276	60.6	23.4*
Rubber, crude, tons	29,429	50,818	29,160	42.1	0.9*
Explosives, 1,000 lb	27,754	27,894	27,284	0.5	1.7*
Paint, varnish, and lacquer, $1,000	22,115	31,289	19,349	29.3	14.3*

* Per cent of increase

100= Monthly Average for 1936
Million Dollars

PRODUCTION AND CONSUMPTION TRENDS



MODERATE UPTURN REPORTED IN MARKET FOR CHEMICALS AND OILS

A QUIET trading movement was reported for the last month with a fair withdrawal against contracts and an irregular demand in the spot market. Buying interest was disappointing to those who had looked for an early revival of trading in anticipation of larger raw material requirements for the spring months. March opened with a little more activity in evidence and, in general, sentiment appeared to be more optimistic regarding the nearby outlook. The decline in the movement of chemicals into actual consumption for the first two months of this year, has been marked. Seasonal influences are now making their presence felt but large consuming industries have not yet improved their positions to such an extent as to encourage belief that broad expansion is in sight. Latest available data may be interpreted as giving evidence that the chemical industry has gone through a relatively quiet period for the year to date and that at present the trend is moderately upward.

In view of the reduced buying interest, prices for most selections have been well maintained. Some reports of selling pressure have been heard and there is reason to believe that stocks of some chemicals have been accumulated because of a disparity between the rate of production and consumption although curtailed operations hold true for both branches of the industry. As usual, vegetable oils and animal fats show a more irregular price trend than is the case for chemicals. Basically, drying oils are in a firm position largely due to uncertainties regarding future supplies of China wood oil and of some of the other oils which might be regarded as substitutes. Yet linseed oil was lowered in price and the reduced quotation was not being adhered to. China wood oil also ran counter to the statistical situation and sold at lower price levels.

Helium is now becoming a material of commerce with the Bureau of Mines prepared to make sales for medicinal, scientific, and commercial uses. In connection with the sale of this gas to Germany a report from abroad states that a plant is being completed at Frankfort-on-Main, home port of the transoceanic airship line, for purifying helium gas with which the cells of the new LZ 130 airship now building will be filled. Especially made containers for transporting the helium from Texas were shipped from Germany some time ago and were available for filling in Houston early in February.

The purification plant is necessary because of the gradual dilution in the airship cells by the penetration therein of air from the outside, reducing the buoyancy of the gas and requiring its regeneration or replacement by fresh gas. Owing to the cost of helium, it would be impracticable to use new gas for each trip so that at stated intervals the helium gas in the ship will be purified and reused.

When hydrogen was employed in German airships, it was not considered economical to purify the gas and diluted gas was simply discharged into the atmosphere and the balloon cells then filled with fresh gas. However, owing to the highly inflammable nature of hydrogen and the great risks resulting therefrom, dramatized by the destruction of the "Von Hindenburg" airship at Lakehurst, the use of hydrogen was banned by the German Government as lifting-gas for Zeppelin airships.

A recent development in the way of proposed legislation has assumed general importance. While aimed directly at the pharmaceutical trade, it may have wider significance.

More drastic regulation of new pharmaceutical developments is proposed by a House subcommittee than has ever been given serious attention before in the halls of Congress. That subcommittee in a revised print of the proposed Food and Drug Law (S. 5) would require that every new drug development get a license from the Department of Agriculture before the new product enters interstate commerce. This is the proposal of the Food and Drug Administration as a result of its investigations of sulfanilimide elixir.

A real battle over this section is expected. Its presence in the bill may prevent prompt enactment. Certainly all food, drug, cosmetic, and pharmaceutical industries will object. They will fear, and rightly, that such regulation will amount almost to an embargo on progress.

It is announced that complete commercial operation of the first Agrol plant for the production of alcohol from domestic farm products started last December and is now turning out alcohol for power—alcohol blends. The plant is located at Atchison, Kans.

Two new oiticica oil crushing plants, with a combined annual capacity of 3,700 metric tons are in operation in Brazil, and plans for another plant capable of handling 2,500 metric tons annually are announced by the Brazil Oiticica, S. A. The plants now operating are located at Mossoro, Rio Grande de Norte and at Pombal, Parahyba. Shortage of crop in Brazil and the increased demand due to conditions in China affecting the supply of tung oil combined to cause increased prices for the oiticica commodity last year.

Casein production plans in Japan have taken on fresh vitality under the spur of the Foreign Exchange Control Law, according to reports reaching Washington. The Japanese at present are entirely dependent for casein supply on imports, while the demand has been increasing steadily, having jumped fifty per cent within the past year. It is now announced that a number of Japanese companies are planning the production of casein from soya beans. Most of these projects are declared to be still in the experimental stage, but the Nippon Denko Kaisha and the Allied Showa Industry Co., both report good results. Other companies announcing their plans for engaging in this industry include Japan Oils and Fats, Honen Oil Company and Bean Chemical Industry Co.

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base = 100 for 1935

This month	**101.11**
Last month	101.22
March, 1937	102.01
March, 1936	99.31

In a slow trading market, prices fluctuated but little. The majority of chemicals were not quotably changed. Lead oxides and basic carbonate of lead were lower and the weighted index dipped slightly.

CHEM. & MET.
Weighted Index of Prices for
OILS AND FATS

Base = 100 for 1935

This month	**84.70**
Last month	83.99
March, 1937	122.74
March, 1936	93.16

There was a mixed price trend in the market for oils and fats. Drying oils, including linseed and china wood, were lower. Cottonseed oil was higher with tallow and grease steady. Net change was in favor of a higher average.

Current PRICES

INDUSTRIAL CHEMICALS

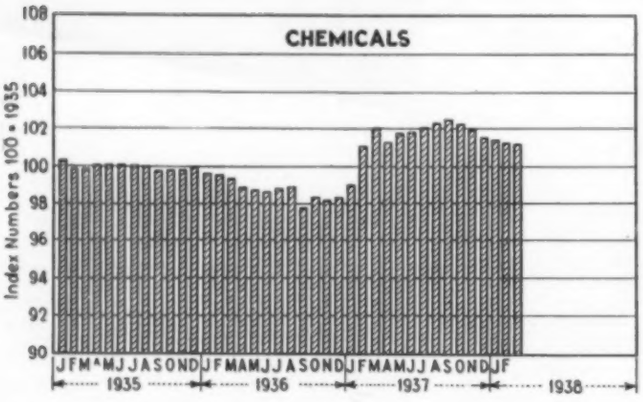
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.05½–$0.06½	$0.05½–$0.06½	$0.07 –$0.08
Acid, acetic, 28%, bbl., cwt.	2.23 – 2.48	2.23 – 2.48	2.25 – 2.50
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.25 –10.50	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	105.00–115.00
Citric, kegs, lb.	.24 – .27	.24 – .27	.25 – .28
Formic, bbl., ton	.10½– .11	.10½– .11	.11 – .11½
Gallic, tech., bbl., lb.	.75 – .78	.75 – .78	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06½	.06½– .06½	.6½ – .6½
Muriatic, 18°, tanks, cwt.	1.05 –.....	1.05 –.....	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.10½– .12
Phosphoric, tech., c'bys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	13.00 –.....	13.00 –.....	11.00 –11.50
Sulphuric, 66°, tanks, ton	16.50 –.....	16.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.40 – .45	.40 – .45	.20 – .30
Tartaric, powd., bbl., lb.	.24½– .25½	.24½– .25½	.21½– .22½
Tungstic, bbl., lb.	2.75 –.....	2.75 –.....	2.50 – 2.75
Alcohol, Amyl	–.....	–.....	–.....
From Pentane, tanks, lb.	.12½–.....	.12½–.....	.12½–.....
Alcohol, Butyl, tanks, lb.	.08½–.....	.08½–.....	.08½–.....
Alcohol, Ethyl, 190p'f., bbl., gal.	4.11 –.....	4.14 –.....	4.14 –.....
Denatured, 190 proof			
No. 1 special, dr., gal wks.	.31 –.....	.34 –.....	.32 –.....
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Potash, lump, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Aluminum sulphate, com bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	2.00 – 2.25	2.00 – 2.25	2.00 – 2.25
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02½	.02½– .02½	.02½– .02½
Ammonia, anhydrous, cyl., lb.	.15½–.....	.15½–.....	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.475–.....	1.475–.....	1.35 –.....
Amylacetate tech., tanks, lb.	.11½– .12	.11½– .12	.11 – .11½
Antimony Oxide, bbl., lb.	.12½– .13	.12½– .13	.16 – .16½
Arsenic, white, powd., bbl., lb.	.03 – .03½	.03 – .03½	.03 – .03½
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	56.50 –58.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	72.00 –74.00
Nitrate, cask, lb.	.07 – .08	.07 – .08	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	46.00 –51.00	46.00 –51.00	44.00 –49.00
Bromine, cs., lb.	.30 – .32	.30 – .32	.36 – .38
Calcium acetate, bags	1.65 –.....	1.65 –.....	2.10 –.....
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06½– .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	21.50 –24.50	21.50 –24.50	20.00 –33.00
flake, dr., del., ton	23.00 –25.00	23.00 –25.00	22.00 –35.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05 – .06	.05 – .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.15 –.....	2.15 –.....	2.15 –.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.67 – 1.70	1.67 – 1.70	1.41 – 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Copper carbonate, bbl., lb.	.09 – .16½	.09 – .16½	.11½– .16
Sulphate, bbl., cwt.	4.25 – 4.50	4.25 – 4.50	5.65 – 5.90
Cream of tartar, bbl., lb.	.19½– .20	.19½– .20	.15 – .15½
Diethylene glycol, dr., lb.	.22 – .23	.22 – .23	.16½– .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80– 2.00
Ethyl acetate, drums, lb.	.06½–.....	.06½–.....	.07 –.....
Formaldehyde, 40%, bbl., lb.	.05½– .06½	.05½– .06½	.05½– .6½
Furfural, dr., lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, ref. drums, lb.	.16 – .18	.16 – .18	.16 – .18
Glaubers salt, bags, cwt.	.95 – 1.00	.95 – 1.00	.85 – 1.00
Glycerine, c.p., drums, extra, lb.	.15½–.....	.15½–.....	.31 –.....
Lead:			
White, basic carbonate, dry casks, lb.	.06½–.....	.06½–.....	.09 –.....
White, basic sulphate, sck., lb.	.05½–.....	.06½–.....	.08½–.....
Red, dry, sck, lb.	.07 –.....	.074–.....	.10 –.....
Lead acetate, white crys., bbl., lb.	.11 – .12	.11 – .12	.11 – .11½
Lead arsenate, powd., bbl., lb.	.13 – .13½	.13 – .13½	.10½– .11
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk., lb.	.06 –	.06 –	.09 –
Lithophone, bags, lb.	.04½– .04½	.04½– .04½	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06½
Methanol, 95%, tanks, gal.	.31 –.....	.31 –.....	.33 –.....
97%, tanks, gal.	.32 –.....	.32 –.....	.32 –.....
Synthetic, tanks, gal.	.33 –.....	.33 –.....	.33 –.....
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.10 –.....	.10½–.....	.13 –.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.24 – .30	.24 – .30	.28 – .32
Potassium bichromate, casks, lb.	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.06½–.....	.06½–.....	.07 – .07½
Chlorate, powd., lb.	.09½–.....	.09½– .09	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 80% bgs., ton	23.00 –.....	23.00 –.....	23.00 –.....
Nitrate, bbl. lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.15 – .16	.15 – .16	.16 – .17
Sal ammoniac, white, casks, lb.	.05 – .05½	.05 – .05½	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.75 – 2.00	1.75 – 2.00	1.75 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.16½– .17	.16½– .17	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.20 – 3.20	2.20 – 3.20	2.15 – 3.15
Nitrate, bags, cwt.	1.45 –.....	1.45 –.....	1.375–.....
Nitrite, casks, lb.	.07 – .08	.07 – .08	.07½– .08
Phosphate, dibasic, bags, lb.	1.85 –.....	1.85 –.....	.02½– .024
Prussiate, yel. drums, lb.	.10 – .11	.10– .11	.10 – .11
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	18.00 –.....	18.00 –.....	18.00– .....
Chloride, dr., lb.	.03 – .04	.03 – .04	.03½– .04
Dioxide, cyl., lb.	.07 – .08	.06½– .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.47 –.....	.47 –.....	.58 –.....
Crystals, bbl., lb.	.33½–.....	.33 –.....	.44 –.....
Zinc, chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.09 – .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.36 – .38
Dust, bbl., lb.	.06½–.....	.06½–.....	.087–.....
Zinc oxide, lead free, bag., lb.	.06½–.....	.06½–.....	.05½–.....
5% lead sulphate, bags, lb.	.06½–.....	.06½–.....	.05½–.....
Sulphate, bbl., cwt.	3.15 – 3.60	3.15 – 3.60	2.65 – 3.00

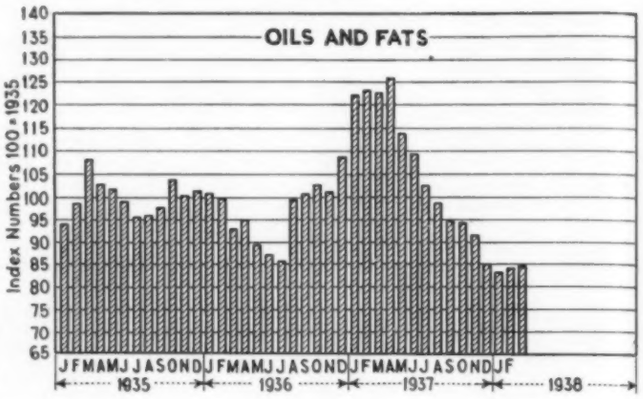
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 14

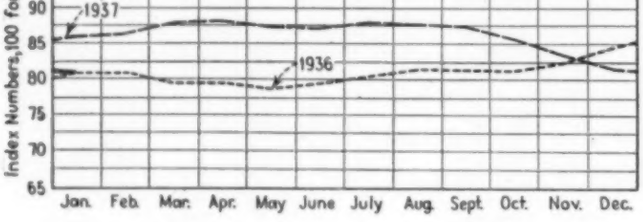
OILS AND FATS

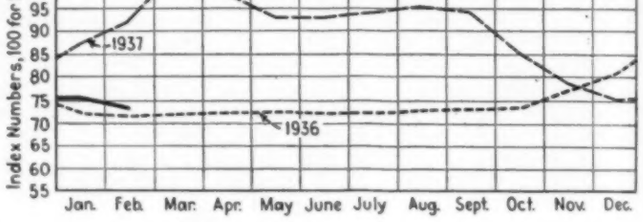
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½–$0.10	$0.09 –$0.10	$0.10½–$0.11
Chinawood oil, bbl., lb.	.14 –.....	.15½–.....	.15½–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.03½–.....	.03½–.....	.09 –.....
Corn oil crude, tanks (f.o.b. mill), lb.	.07½	.07½–.....	.10 –.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07 –.....	.06½–.....	.09½–.....
Linseed oil, raw car lots, bbl., lb.	.097–.....	.099–.....	.10 –.....
Palm, casks, lb.	.04 –.....	.04½–.....	.06½–.....
Peanut oil, crude, tanks (mill), lb.	.07½–.....	.06½–.....	.10½–.....
Rapeseed oil, refined, bbl., gal.	.90 –.....	.90 –.....	.87 –.....
Soya bean, tank, lb.	.06½–.....	.06½–.....	.10 –.....
Sulphur (olive foots), bbl., lb.	.09 –.....	.09½–.....	.12½–.....
Cod, Newfoundland, bbl., gal.	.52 –.....	.52 –.....	.51 –.....
Menhaden, light pressed, bbl., lb.	.087–.....	.074–.....	.088–.....
Crude, tanks (f.o.b. factory), gal.	.37½–.....	.37½–.....	.40 –.....
Grease, yellow, loose, lb.	.04½–.....	.04½–.....	.08½–.....
Oleo stearine, lb.	.07½–.....	.07½–.....	.10½–.....
Oleo oil, No. 1	.09 –.....	.09½–.....	.15 –.....
Red oil, distilled, d.p. bbl., lb.	.09½–.....	.09½–.....	.10½–.....
Tallow extra, loose, lb.	.05½–.....	.05½–.....	.08½–.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.52 -$0.55	$0.52 -$0.55	$0.60 -$0.62
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.15 - .16
Aniline salts, bbl., lb.	.22 - .24	.22 - .24	.24 - .25
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	1.10 - 1.25
Benzidine base, bbl., lb.	.70 - .75	.70 - .75	.65 - .67
Benzoic acid, U.S.P., kgs., lb.	.52 - .54	.52 - .54	.52 - .54
Benzyl chloride, tech., dr., lb.	.25 - .27	.25 - .27	.35 - .40
Benzol, 90%, tanks, works, gal.	.16 - .18	.16 - .18	.16 - .18
Beta-napthol, tech., drums, lb.	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb.	.12 - .13	.12 - .13	.10 - .11
Cresylic acid, 99%, dr., wks., gal.	.89 - .92	.89 - .92	.73 - .75
Diethylaniline, dr., lb.	.40 - .45	.40 - .45	.55 - .58
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluen, bbl., lb.	.15 - .16	.15 - .16	.16 - .17
Dip oil, 15%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.32 - .36	.32 - .36	.32 - .36
H-acid, bbl., lb.	.50 - .55	.50 - .55	.55 - .60
Naphthalene, flake, bbl., lb.	.07½- .07¾	.07½- .07¾	.07½- .07¾
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08¼- .10
Para-nitraniline, bbl., lb.	.50 - .52	.50 - .52	.45 - .47
Phenol, U.S.P., drums, lb.	.14½-	.14½-	.13½- .14
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.30 - .40
Pyridine, dr., gal.	1.55 - 1.60	1.55 - 1.60	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.75 - .80	.75 - .80	.70 - .75
Salicylic acid, tech., bbl., lb.	.33 - .40	.33 - .40	.34 - .40
Solvent naptha, w.w., tanks, gal.	.30 -	.30 -	.26 - .....
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.35 -	.35 -	.30 - .....
Xylene, com, tanks, gal.	.35 -	.35 -	.30 - .....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.08½- .12	.09½- .12	.18½- .20
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb.	.02½- .30	.0295- .30	.04 - .30
Prussian blue, bbl., lb.	.36 - .37	.36 - .37	.37 - .38
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.10 - .26
Chrome green, bbl., lb.	.21 - .30	.21 - .30	.26 - .27
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.	1.45 - 1.50	1.55 - 1.60	1.72 - 1.75
Chrome yellow, C. P., bbl., lb.	.14½- .15½	.14½- .15½	.13 - .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 - .06½	.06 - .06½	.07 - .08½
Gum copal Congo, bags, lb.	.08 - .30	.08 - .30	.08 - .30
Manila, bags, lb.	.08½- .14	.08½- .14	.09 - .14
Damar, Batavia, cases, lb.	.16 - .24	.16 - .24	.15½- .16
Kauri cases, lb.	.18½- .60	.18½- .60	.19 - .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -.....	50.00 -.....	50.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .04	.03 - .04	.03 - .04
Rosin, H., bbl.	6.40 -.....	7.05 -.....	10.60 -.....
Turpentine, gal.	.34½-.....	.31 -.....	.46 -.....
Shellac, orange, fine, bags, lb.	.21 -.....	.21 -.....	.25 -.....
Bleached, bonedry, bags, lb.	.17 -.....	.17 -.....	.21 -.....
T. N. Bags, lb.	.11½-.....	.12 -.....	.14 -.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

MANNING, MAXWELL & MOORE, INC., Bridgeport, Conn., has opened new territorial headquarters at Charlotte, N. C. with Paul Hayden in charge; Jacksonville, Fla., W. H. Kissam; New Orleans, R. F. Heath; Minneapolis, K. W. Johnsson; and Columbus, W. S. Adams.

PENNSYLVANIA SALT MFG. CO., Philadelphia, has added a hydrogen peroxide unit to its plant at Wyandotte, Mich.

LUDLUM STEEL CO., Watervliet, N. Y. has appointed Gerald D. Howk as its mill representative in the Cincinnati territory. Mr. Howk will be located at 208 Elm St., Cincinnati.

AUDUBON WIRE CLOTH CORP., Philadelphia, has appointed G. J. Hawkey, Cleveland Duplex Machinery Co., to handle the sale of its products in the Cleveland territory.

E. I. DU PONT DE NEMOURS & CO., INC., Wilmington, has formed an electroplating chemicals division, headed by J. C. Pickard.

GENERAL ALLOY CO., Boston, has appointed George O. Desautels Co., Indianapolis and Muncie, as its sales representative for central Indiana.

SOUTH BEND AIR PRODUCTS, INC., South Bend, Ind., has been organized to take over the ventilating equipment business formerly conducted by the industrial fan division of the Bendix Products Corp. Marshall A. Smith, Jr. is president and general manager of the new company.

SPROUT, WALDRON & CO., Muncy, Pa., has appointed W. S. Otto as district sales engineer for the St. Louis territory with headquarters at 3509 Cherokee St.

CHEMICAL EQUIPMENT CORP., successor to Chemical Equipment Co., Montpelier, Ind., has appointed Hugh E. Weightman technical director.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1938	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$80,000	.....	$120,000	$80,000
Middle Atlantic	2,390,000	$1,123,000	3,909,000	80,000
South	1,600,000	.....	7,200,000	1,240,000
Middle West	500,000	1,615,000	9,870,000	1,830,000
West of Mississippi	1,375,000	260,000	2,955,000	4,380,000
Far West	40,000	40,000	130,000	1,812,000
Canada	1,050,000	40,000	2,145,000	40,000
Total	$7,035,000	$3,078,000	$26,329,000	$9,462,000

PROPOSED WORK

Cement Plant—Modern Cement Co., Inc., Valley Stream, N. Y., plans to rebuild its cement plant recently destroyed by an explosion.

Chemical Plant—The Jordan Co., 2630 West Arthington St., Chicago, Ill., is having plans prepared by N. Ronnenberg, Inc., archts., 10 South La Salle St., Chicago, for the construction of a chemical plant, at Westmount, a suburb of Chicago. Estimated cost $300,000.

Cotton Oil Mill—Corporation c/o G. T. Davenport, Oklahoma City, Okla., contemplates repairs and alterations to cotton oil mill at Oklahoma City. Estimated cost will exceed $40,000.

Distillery — Green Mountain Distillery, Inc., Burlington, Vt., plans improvements to its distillery. Estimated cost will exceed $40,000.

Distillery—Old Kennebec Distilling Co., Frankfort, Ky., plans new distillery building, also repairs and alterations to bottling plant and power plant. Estimated cost will exceed $100,000. Maturity indefinite.

Factory—Armstrong Rubber Co., Inc., 475 Elm St., West Haven, Conn., is having plans prepared for a factory at Natchez, Miss., to manufacture rubber tires to be distributed through Sears, Roebuck Co., in the South. Estimated cost $300,000. Company plans to spend $1,000,000 for machinery and equipment.

Factory—Bakelite Corporation, 247 Park Ave., New York, N. Y., contemplates the construction of a factory at New Toronto, Ont., Can. Estimated cost $100,000.

Factory—Bill Baker, 1315 Chaparrel St., Corpus Christi, Tex., plans to construct a 1 and 2 story plant for the manufacture of interlocking building tile and also for the manufacture of machines for the manufacture of tile.

Factory—Castilian Products Corp., 1027 Seward St., Los Angeles, Calif., manufacturer of cosmetics, plans to construct a factory. Estimated cost may exceed $40,000.

Factory—General Plastics, Inc., Walck Rd., North Tonawanda, N. Y., plans to construct an addition to its factory to be used for the manufacture of synthetic phenol. Estimated cost $500,000.

Factory—U. S. Fruit Products & Vegetable Products Station, c/o J. L. Heid, Chief Chemist, Weslaco, Tex., plans to construct a 1 story, 80x110 ft. chemistry and experimental plant to include large space for canning tests. Estimated cost $45,000 or more.

Gas Plant—City Council, Jamestown, N. Y., over-rode Mayor's veto to construct municipal gas plant and distribution system and work on project will proceed at once. R. Holmes, Mt. Vernon, N. Y., Consulting Engr. Estimated cost $1,200,000.

Gas Plant—Citizens Gas & Coke Utility, 47 South Penn Ave., Indianapolis, Ind., plans improvements to its plant here. Estimated cost $200,000.

Gas System—City, Edcouch, Tex., plans to install a municipal gas distributing system to include booster unit, etc. H. H. Kidder, San Juan, Tex., Engr. Estimated cost $25,000.

Gasoline Cracking Plant—Esson Oil Co., Enid, Okla., plans to rebuild its gasoline cracking plant recently destroyed by fire. Estimated cost $350,000.

Gasoline Plant—Phillips Petroleum Co., Bartlesville, Okla., plans to construct a natural gasoline plant at Wichita Falls, Tex. A. H. Rinery, Bartlesville, Engr. Estimated cost $500,000.

Laboratory—Province of Ontario, Hon. H. J. Kirby, Minister of Health, Department of Health, Toronto, Ont., Can., plans to construct a laboratory building and purchase equipment. Estimated cost $150,000.

Leather Factory — Steinhardt Leather Co., McWhorter and Olive Sts., Newark, N. J., plans to construct a factory. Estimated cost including equipment $40,000.

Oil Refinery—Healey Petroleum Corp., W. J. Healey, Pres., Bradford, Pa., plans extensive development of its crude oil properties on Music Mountain, McKean Co., maturity soon. Estimated cost $30,000.

Oil Refinery—George E. Lilly & Associates, Houston and Palestine, Tex., plan to construct a recycling and stripping plant in the Long Lake Pool, near Palestine. The plant will be fed from vast holdings of owners in the Palestine area. Complete machinery and equipment will be purchased. Estimated cost $275,000.

Oil Refinery—Portex Oil Co., Joaquin, Tex., plans to construct an oil refinery and storage building. Estimated cost $90,000.

Oil Refinery—Sunray Oil Co., Wichita Falls, Tex., plans to construct an oil refinery near Wichita Falls. Estimated cost will exceed $50,000.

Paint Factory — McCann-Shields Paint Co., 27 Alexander Ave., Pittsburgh, Pa., will soon take bids for the construction of a 4 story, 54x125 ft. paint factory. H. H. Cahoon, 337 Blvd. of the Allies, Pittsburgh, Archt. Estimated cost $40,000.

Paint Factory—Norfolk Paint & Varnish Co., Newport Ave., North Quincy, Mass., plans extensive alterations and modernization to paint and varnish factory. Wesley H. Blank, 120 Milk St., Boston, Mass., Archt. Estimated cost $40,000.

Pigment Extraction Plant—Sherwin-Williams Co., 101 Prospect Ave., N. W., Cleveland, O., plans the construction of a pigment extraction plant on the site of the old Pusey & Jones shipyard at Gloucester, N. J. Estimated cost including cost of site $500,000.

Pulp Mill—Quebec Pulp & Paper Corp., 132 St. James St., W., Montreal, Que., Can., is having plans prepared for the modernization of its pulp mill at Chicoutimi, Que. Estimated cost $200,000.

Sulphur Plant—Aldermac Copper Corp., Noranda, Que., Can., plans to construct and equip a plant to extract sulphur from iron pyrites. Estimated cost $600,000.

Sugar Refinery—Breaux Bridge Sugar Co-operative, R. L. Angello, Pres., Breaux Bridge, La., plans to construct a sugar refinery. Estimated cost $200,000.

Warehouse—Proctor & Gamble Co., Cincinnati, O., plans to construct a 2 story, 70x140 ft. warehouse at Marriott and Decatur Sts., Baltimore, Md. Bids are now being received and contract will soon be awarded. Estimated cost $40,000.

CONTRACTS AWARDED

Abrasives Factory—Titan Abrasives Co., Inc., 1348 West 59th St., Chicago, Ill., has awarded the contract for an addition to its factory to Emil Anderson Co., Inc., 228 North La Salle St., Chicago. Estimated cost $50,000.

Bark Burner—Lake Sulphide Pulp Co., Ltd., Port Arthur, Ont., Can., has awarded the contract for the construction of a bark burner at its pulp mill at Red Rock near Nipigon, Ont., to Port Arthur Shipbuilding Co., Ltd., Port Arthur.

Factory—Agfa Ansco Corp., 29 Charles St., Binghamton, N. Y., has awarded the contract for alterations and additions to factory building No. 42 to Wigton-Abbott Corp., 1225 South Ave., Plainfield, N. J. Estimated cost will exceed $40,000.

Factory—Bakelite Corp., 247 Park Ave., New York, N. Y., has awarded the contract for alterations to its factory on Grove St., Bloomfield, N. J., to Lawrence C. Roberts, Inc., 10 East 41st St., New York, N. Y. Estimated cost $43,000.

Factory—Carborundum Co., Buffalo Ave., Niagara Falls, N. Y., has awarded the contract for plant addition No. 32, resenoid building, to Walter S. Johnson Building Co., Inc., 2532 Hyde Park Blvd., Niagara Falls.

Factory—Johns-Mansville Corp., Fiber-Conduit Division, Richmond, Ind., has awarded the contract for a 1 story brick addition to its factory on North West 7th St., Richmond, to Hughes-Foulkrod Co., Schaff Bldg., Philadelphia, Pa. Estimated cost $60,000.

Factory—Sheridan Pressed Brick & Tile Co., F. Kneisel, Mgr., Sheridan, Wyo., is enlarging its plant, installing new round downdraft kiln and repairing present buildings. Work is being done by day labor.

Glass Factory—Anchor Hocking Glass Co., P. L. Hershfield, Mgr., Union City, Ind., has awarded the contract for three factory units at its plant at Winchester, Ind., to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $80,000.

Oil Refinery—Roosevelt Oil Corporation, Mt. Pleasant, Mich., will construct an oil refinery. Work will be done by separate contracts. Vacuum equipment has been awarded to Muskegon Boiler Works, Muskegon, Mich. Estimated cost $250,000.

Oil Refinery—Sun Oil Co., H. Thomas, Director of Purchases, 1608 Walnut St., Philadelphia, Pa., will improve its refineries at Marcus Hook, Pa., and Toledo, O. Work will be done by separate contracts. Estimated cost $1,000,000 each. This is part of $11,000,000 expansion program.

Oil Refinery — Texas Co., 929 South Bway., Los Angeles, Calif., has awarded the contract for "Stratcold" oil treatment plant to Stratford Engineering Corp., 1414 Dierks Bldg., Kansas City, Mo., $220,000.

Oil Refinery — Wasatch Oil & Refining Co., Salt Lake City, Utah, will construct a refinery and modern cracking unit at Pocatello, Idaho, to have a capacity of 1,000 to 1,500 bbl. per day.

Zinc Mill—Illinois Zinc Co., 47th St. and Sacramento Ave., Chicago, Ill., has awarded the contract for a strip rolling mill to Austin Co., 510 North Dearborn St., Chicago, Ill. Estimated cost $175,000.

RECORD TONNAGE OF ALUMINUM PRODUCED IN UNITED STATES LAST YEAR

A REVIEW of the aluminum industry for last year has just been released by the U. S. Bureau of Mines. Prepared by Herbert A. Franke and C. T. Herring, the review is of particular interest because of the comprehensive way it treats of consuming outlets in different industries.

A greater tonnage of new aluminum was produced in the United States during 1937 than in any other year. The 1937 record output of virgin aluminum amounted to 292,681,000 pounds valued at $55,609,000, compared with 224,929,000 pounds valued at $41,612,000 in 1936. Production in 1937 was 30 per cent greater than in 1936 and exceeded the previous peak reached in 1930 by 28 per cent.

The principal producing plant was that at Massena, New York, where approximately 37 per cent of the metal made in the United States in 1937 was produced. The works at Alcoa, Tennessee, accounted for 31 per cent of the output and the plants at Badin, North Carolina, and Niagara Falls, New York, contributed the remaining 32 per cent.

Foreign trade in unmanufactured aluminum in 1937 showed a sharp increase in imports and exports. Imports of ingots, scrap and alloys rose from 25,158,541 pounds in 1936 to 44,701,669 pounds in 1937, and exports increased from 953,546 to 4,719,034 pounds. Imports of sheets, tubes, utensils and other manufactured products increased in value from $1,108,630 in 1936 to $1,407,200 in 1937; exports advanced from $1,479,520 to $1,975,872. Foreign trade in manufactured aluminum is relatively small in comparison with the large domestic production and consumption. Data on imports and exports were obtained from the Bureau of Foreign and Domestic Commerce.

The Aluminum Company of America started a $26,000,000 expansion program in 1937, a large part of which will be completed in 1938. This will include the new alumina plant at Mobile, Alabama, a new extrusion mill at Lafayette, Indiana, a new sand foundry and forging plant at Los Angeles, California, and expansion of the large aluminum rolling mill at Edgewater, New Jersey. A longer period of time will be necessary to double the present capacity of the aluminum-reduction works at Alcoa, Tennessee.

Although there was a sharp recession in business during the closing months of 1937, more aluminum was purchased in the United States during the year than ever before. This was due not only to the tremendous industrial demand earlier in the year, but to the discovery of new uses and the general broadening of sound and practical applications for aluminum. The service and performance rendered by aluminum emergency bulkheads constructed at the Gallipolis Dam on the Ohio River two years ago resulted in the application of similar bulkheads for the Emsworth Dam, northwest of Pittsburgh. Each aluminum bulkhead weighs only 15 tons whereas a steel bulkhead, just two-thirds as high, would have weighed 28 tons. Moreover buildings in Pittsburgh installed movable aluminum bulkheads, 12 feet in height, to serve as a protection against heavy floods.

The consumption of aluminum cable was the greatest in the history of the industry. To the 430,000 miles or more of aluminum cable, steel reinforced, already in use in the United States and Canada, additions included a 237-mile transmission line from Boulder Dam to the Colorado River Aqueduct and more than 100,000 miles of rural distribution lines. Aluminum cable is being used for a 230,000-volt line from Boulder Dam to Los Angeles, now under construction.

The transportation industry, which consumes 33 per cent of the domestic aluminum output, found new uses for the light but strong metal. The order by the Interstate Commerce Commission permitting the construction of aluminum tank cars for transportation of aviation gasoline opens a new field hitherto inaccessible. It will probably be possible to transport other highly volatile chemicals in similar containers. Aluminum railroad passenger coaches, dining cars, kitchen-dormitory cars, and engine cabs are in operation. Fifty all-aluminum street cars are now under construction. Aluminum, long an important metal for the air, is still expanding its possibilities in the aviation field. Aluminum played a large part in the construction of the huge Boeing DC-4 and clipper ships, the 46-passenger Martin clipper built for Russia, and the army plane, Airacuda. In the marine field, a new aluminum mast was made for America's Cup boat Ranger and streamlined masts were used on iceboats. Twenty-two aluminum lifeboats, each seating 99 persons, were constructed in England for the Nieuw Amsterdam, flagship of the Holland-America Line. Each of three ferry boats to ply between New York and Staten Island used 55,000 pounds of aluminum for construction of shade decks and pilot houses.

Because of its high resistance to corrosion and lightness, aluminum is used for the manufacture of gratings and catwalks for sewage plants. More than 2,800 diffuser plate holders of aluminum were made for one of Cleveland's sewage disposal plants. A chemical plant installed four aluminum tanks, each of 80,000-gallon capacity.

Among the many newer uses for aluminum are listed aluminum as an ingredient in roofing material, aluminum windows and venetian blinds for the home and office, church steeples, statues, and musical instruments. For the highway there are aluminum marker plates, automobile license plates, and the Alzak automobile headlight reflectors which give greater diffusion at the end of the highway beam, thus reducing glare for the approaching motorist.

Deliveries of Potash Salts In 1937

The American Potash Institute announces that potash deliveries within the continental United States, Canada, Cuba, Puerto Rico and Hawaii during the fourth quarter of the calendar year 1937 amounted to 187,864 tons of actual K_2O. This was equivalent to 367,684 tons of potash salts. Constituting this total were 266,933 tons of muriate, 20,559 tons of manure salts, 36,415 tons of sulphate, 34,181 tons of kainit and 9,596 tons of sulphate of potash magnesia. These figures include salts of domestic and foreign origin, exclusive of importations of potassium nitrate.

In terms of regional consignments, the total of 152,959 tons K_2O delivered within the continental United States was shipped as follows: Northeastern and Mid-Atlantic states 33,443 tons; Southern states (including Virginia) 98,954 tons; Mid-western states 11,868 tons; and West Coast states 5,231 tons; chemical potash 3,463 tons K_2O. The balance of 34,905 tons K_2O was delivered to Canada, Cuba, Puerto Rico and Hawaii.

For the twelve months (Jan.-Dec. inclusive) deliveries of K_2O amounted to 516,558 tons, equivalent to 1,007,515 tons of potash salts, consisting of 738,866 tons muriate; 55,066 tons manure salts, 86,660 tons sulphate; 106,289 tons kainit; and 20,634 tons of sulphate of potash magnesia. Regional distribution on a K_2O basis was as follows: Northeastern and Mid-Atlantic states, 116,816 tons; Southern states (Virginia included) 259,210 tons; Mid-western states, 38,986 tons; West Coast states 13,351 tons; chemical potash 17,997; the remainder, 70,198 tons K_2O, was delivered to Canada, Cuba, Puerto Rico and Hawaii.